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Edition 2.0 2023-03

INTERNATIONAL STANDARD

Industrial communication networks – Fieldbus specifications – Part 5-26: Application layer service definition – Type 26 elements



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INTERNATIONAL STANDARD

Industrial communication networks – Fieldbus specifications – Part 5-26: Application layer service definition – Type 26 elements

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-26: Application layer service definition – Type 26 elements

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

IEC 61158-5-26 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This second edition cancels and replaces the first edition published in 2019. This edition constitutes a technical revision.

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

a) expand Common-memory-area as a new Common-memory-area-3 (CM3);
b) add new services with expansion of Common-memory-area:
   – Extended-cyclic-data transfer service;
   – Extended-participation-request service;
   – Extended-network-parameter-read service;
   – Extended-network-parameter-write service.

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

Draft	Report on voting
65C/1203/FDIS	65C/1244/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 document will remain unchanged until the stability date indicated on the IEC web site under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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 can 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.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-26: Application layer service definition – Type 26 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 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 26 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 document defines in an abstract way the externally visible service provided by the Type26 fieldbus application layer in terms of:

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

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

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

This document specifies the structure and services of the Type 26 fieldbus application layer, in conformance with the OSI Basic Reference Model (see ISO/IEC 7498-1) and the OSI Application Layer Structure (see 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 document to provide access to the FAL to control certain aspects of its operation.

1.2 Specifications

The principal objective of this document 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 subparts of IEC 61158-6.

This document can 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 document 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 this application layer service definition standard. Instead, conformance is achieved through implementation of conforming application layer protocols that fulfill the Type 26 application layer services as defined in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE All parts of the IEC 61158 series, as well as the IEC 61784-1 series and the IEC 61784-2 series are maintained simultaneously. Cross-references to these documents within the text therefore refer to the editions as dated in this list of normative references.

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

IEC 61158-1:2023, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-6-26:2023, *Industrial communication networks – Fieldbus specifications – Part 6-26: Application layer protocol specification – Type 26 elements*

IEC 61784-2-21:2023, *Industrial networks – Profiles – Part 2-21: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 21*

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/IEEE 8802-3, *Telecommunications and exchange between information technology systems − Requirements for local and metropolitan area networks − Part 3: Standard for Ethernet*

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

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

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

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

ISO/IEC 60559, *Floating-Point arithmetic*

IETF RFC 768, J. Postel, *User Datagram Protocol*, August 1980, available at https://www.rfc-editor.org/info/rfc768 [viewed 2022-02-18]

IETF RFC 791, J. Postel, *Internet Protocol*, September 1981, available at https://www.rfc-editor.org/info/rfc791 [viewed 2022-02-18]

IETF RFC 792, J. Postel, *Internet Control Message Protocol*, September 1981, available at https://www.rfc-editor.org/info/rfc792 [viewed 2022-02-18]

IETF RFC 793, J. Postel, *Transmission Control Protocol*, September 1981, available at https://www.rfc-editor.org/info/rfc793 [viewed 2022-02-18]

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IETF RFC 922, J.C. Mogul, *Broadcasting Internet datagrams in the presence of subnets*, October 1984, available at https://www.rfc-editor.org/info/rfc922 [viewed 2022-02-18]

IETF RFC 950, J.C. Mogul and J. Postel, *Internet Standard Subnetting Procedure*, August 1985, available at https://www.rfc-editor.org/info/rfc950 [viewed 2022-02-18]

3 Terms, definitions, symbols, abbreviated terms and conventions

For the purposes of this document, the following terms, definitions, symbols, abbreviated terms and conventions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1 Terms and definitions from other ISO/IEC standards

3.1.1 Terms and definitions from ISO/IEC 7498-1

For the purposes of this document, the following terms and definitions given in ISO/IEC 7498-1 apply.

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

3.1.2 Terms and definitions from ISO/IEC 8822

For the purposes of this document, the following terms and definitions given in ISO/IEC 8822 apply.

a) abstract syntax
b) presentation context

3.1.3 Terms and definitions from ISO/IEC 9545

For the purposes of this document, the following terms and definitions given 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

3.1.4 Terms and definitions from ISO/IEC 8824-1

For the purposes of this document, the following terms and definitions given in ISO/IEC 8824-1 apply.

a) object identifier
b) type
c) value
d) simple type
e) structured type
f) tag
g) Boolean type
h) true
i) false
j) integer type
k) bitstring type
l) octetstring type

3.2 Fieldbus application layer Type 26-specific definitions

For the purposes of this document, the following terms and definitions apply.

3.2.1
application
function or data structure for which data is consumed or produced

3.2.2
application objects
multiple object classes that manage and provide a run time exchange of messages across the network and within the network device

3.2.3
application process object
component of an application process that is identifiable and accessible through an FAL application relationship

Note 1 to entry: 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 objects can 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.

3.2.4
application process object class
class of application process objects defined in terms of the set of their network-accessible attributes and services

3.2.5
application relationship
cooperative association between two or more application-entity-invocations for the purpose of exchange of information and coordination of their joint operation

Note 1 to entry: This relationship is activated either by the exchange of application-protocol-data-units or as a result of preconfiguration activities.

3.2.6
application relationship ASE
ASE used for establishing and terminating application relationship

3.2.7
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 1 to entry: Each application process involved in the application relationship maintains its own application relationship endpoint.

3.2.8
attribute
description of an externally visible characteristic or feature of an object

Note 1 to entry: 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 can also affect the behavior of an object. Attributes are divided into class attributes and instance attributes.

3.2.9
behavior
indication of how an object responds to particular events

3.2.10
channel
single physical or logical link of an input or output application object of a server to the process

3.2.11
class
set of objects, all of which represent the same kind of system component

Note 1 to entry: A class is a generalization of an object; a template for defining variables and methods. All objects in a class are identical in form and behavior, but usually contain different data in their attributes.

3.2.12
class attributes
attribute that is shared by all objects within the same class

3.2.13
client
<object view> object which uses the services of another (server) object to perform a task

3.2.14
client
<communication view> initiator of a message to which a server reacts

3.2.15
common-memory
virtual memory accessible with logically unique address used for the cyclic-data transmission

Note 1 to entry: It is composed of the memory-area-1, -2 and -3 of the memory size 512 words, 8 192 words and 1 048 576 words respectively and is shared with the Type 26 nodes in a Type 26 fieldbus network.

3.2.16
connection
logical binding between application objects that are within the same or different devices

Note 1 to entry: Connections can be either point-to-point or multipoint.

3.2.17
consumer
node or sink that is receiving data from a producer

3.2.18
control commands
action invocations transferred from client to server to clear outputs, freeze inputs and/or synchronize outputs

3.2.19
cyclic
repetitive in a regular manner

3.2.20
cyclic-data frame
frame used for the Type 26 cyclic-data transmission

3.2.21
cyclic-data transmission
data transmission with which a Type 26 node sends out data on a pre-assigned area for the node on the common-memory, in broadcasting to all other Type 26 nodes every time the node obtains a token

3.2.22
dedicated AR
AR used directly by the FAL User

Note 1 to entry: On dedicated ARs, only the FAL Header and the user data are transferred.

3.2.23
device
physical hardware connected to the link

Note 1 to entry: A device can contain one or more than one node.

3.2.24
device profile
collection of device dependent information and functionality providing consistency between similar devices of the same device type

3.2.25
end node
producing or consuming node

3.2.26
endpoint
one of the communicating entities involved in a connection

3.2.27
error
discrepancy between a computed, observed or measured value or condition and the specified or theoretically correct value or condition

3.2.28
event
instance of a change of conditions

3.2.29
FA-link protocol
communication protocol for Type 26 fieldbus

Note 1 to entry: It defines the token management, the cyclic data transmission and the message data transmission, with which each Type 26 node performs data transmission on an equal basis.

3.2.30
FAL subnet
subnetworks composed of one or more data link segments, identified by a subset of the network address

3.2.31
frame
synonym for DLPDU

3.2.32
invocation
act of using a service or other resource of an application process

Note 1 to entry: Each invocation represents a separate thread of control that can be described by its context. Once the service completes, or use of the resource is released, the invocation ceases to exist. For service invocations, a service that has been initiated but not yet completed is referred to as an outstanding service invocation.

3.2.33
index
address of an object within an application process

3.2.34
instance
actual physical occurrence of an object within a class that identifies one of many objects within the same object class

EXAMPLE California is an instance of the object class state.

Note 1 to entry: The terms object, instance, and object instance are used to refer to a specific instance.

3.2.35
instance attributes
attribute that is unique to an object instance and not shared by the object class

3.2.36
instantiated
object that has been created in a device

3.2.37
logical device
FAL class that abstracts a software component or a firmware component as an autonomous self-contained facility of an automation device

3.2.38
management information
network-accessible information that supports managing the operation of the fieldbus system, including the application layer

Note 1 to entry: Managing includes functions such as controlling, monitoring, and diagnosing.

3.2.39
message-data frame
frame used for the Type 26 message-data transmission

3.2.40
message-data transmission
sporadic data transmission with which a Type 26 node sends out the message data of request, response, information report, notification upon event happened at the node and so forth, to other Type 26 nodes

3.2.41
method
synonym for an operational service which is provided by the server ASE and invoked by a client

3.2.42
module
hardware or logical component of a physical device

3.2.43
multipoint connection
connection from one node to many

Note 1 to entry: Multipoint connections allow messages from a single producer to be received by many consumer nodes.

3.2.44
network
set of nodes connected by some type of communication medium, including any intervening repeaters, bridges, routers and lower-layer gateways

3.2.45
network load measurement function
provision for monitoring and measurement of the communication load over a Type 26 fieldbus with a Type 26 node

3.2.46
object
abstract representation of a particular component within a device, usually a collection of related data (in the form of variables) and methods (procedures) for operating on that data that have clearly defined interface and behavior

3.2.47
participation-request-frame
frame used for a Type 26 node notifying of its participation-request in a Type 26 fieldbus network

3.2.48
peer
role of an AR endpoint in which it is capable of acting as both client and server

3.2.49
physical device
automation or other network device

3.2.50
point-to-point connection
connection that exists between exactly two application objects

3.2.51
property
general term for descriptive information about an object

3.2.52
protocol type
identification of communication protocol

3.2.53
publisher
role of an AR endpoint that transmits APDUs onto the fieldbus for consumption by one or more subscribers

Note 1 to entry: A publisher cannot be aware of the identity or the number of subscribers and it can publish its APDUs using a dedicated AR.

3.2.54
pull publisher
type of publisher that publishes an object in response to a request received from its pull publishing manager

3.2.55
pull publishing manager
type of publishing manager that requests that a specified object be published in a corresponding response APDU

3.2.56
push publisher
type of publisher that publishes an object in an unconfirmed service request APDU

3.2.57
push publishing manager
type of publishing manager that requests that a specified object be published using an unconfirmed service

3.2.58
push subscriber
type of subscriber that recognizes received unconfirmed service request APDUs as published object data

3.2.59
resource
processing or information capability of a subsystem

3.2.60
sequence number
consecutive number used to determine whether a receiving message-data from other nodes has been previously received and is redundant

Note 1 to entry: The sequence number of a node is set to 0 (zero) at the time of the network-startup, and it is incremented by 1 (one) every time a message-data transmission is completed. The sequence number of the node is transmitted to other nodes by the message-data transmission.

3.2.61
server
<communication view> role of an AREP in which it returns a confirmed service response APDU to the client that initiated the request

3.2.62
server
<object view> object which provides services to another (client) object

3.2.63
service
operation or function than an object and/or object class performs upon request from another object and/or object class

3.2.64
subscriber
role of an AREP in which it receives APDUs produced by a publisher

3.2.65
token
right to send out data on the transmission medium, which is passed successively from node to node for Type 26 fieldbus network

3.2.66
token-frame
frame used for hand-over the token between Type 26 nodes

3.2.67
transaction code
code used to discriminate and identify each data transmission frame, and which represents the transaction of a receiving frame

3.2.68
trigger-frame
frame used in the network-startup state for a Type 26 node notifying of its entrance into a new participation-request over a Type 26 fieldbus network

3.2.69
valid-linking state
state in which a token is consecutively circulated among nodes over Type 26 fieldbus network

3.2.70
version of sequence number
version number of the sequence number in a receiving message-data from other nodes, used to determine whether the receiving message-data is valid and is not overdue

Note 1 to entry: The value is set at the time when a Type 26 node completes to participate in a Type 26 fieldbus network, and is maintained until the node drops out of the Type 26 fieldbus network.

3.2.71
virtual-address-space
virtual memory space with pseudo logical address, used for the message-transmission

3.3 Abbreviated terms and symbols

AE	Application entity
AL	Application layer
ALME	Application layer management entity
ALP	Application layer protocol
ALS	Application layer service
AP	Application process
APO	Application process object
APDU	Application protocol data unit
AR	Application relationship
AREP	Application relationship endpoint

ASCII	American Standard Code for Information Interchange
ASE	Application service element
BCT	Broadcast transmission
C_AD1	Data-head-address on common-memory-area-1
C_AD2	Data-head-address on common-memory-area-2
C_AD3	Data-head-address on common-memory-area-3
CIM	Computer integrated manufacturing
CM	Common-memory
CM1	Common-memory-area-1
CM2	Common-memory-area-2
CM3	Common-memory-area-3
Cnf	Confirmation
C_SZ1	Data-size on common-memory-area-1
C_SZ2	Data-size on common-memory-area-2
C_SZ3	Data-size on common-memory-area-3
DA	Destination-address
DL-	(as a prefix) data-link-
DLC	Data-link connection
DLCEP	Data-link connection endpoint
DLL	Data-link layer
DLS	Data-link service
DLSAP	Data-link service access point
DLSDU	DL-service-data-unit
DNA	Destination-node-number
DNS	Domain name service
FAL	Fieldbus application layer
HMI	Human-machine interface
H_TYPE	Header-type
ID	Identifier
IEC	International Electrotechnical Commission
Ind	Indication
IP	Internet protocol
ISO	International Organization for Standardization
LME	Layer management entity
LSB	Least Significant Bit
M_ADD	Message-offset-address in the virtual-address-space
MAC	Media Access Control
MAJ_VER	FA-link protocol version: major-version
M_CTL	Message-control
MFT	Allowable-minimum-frame-interval-time
MIN_VER	FA-link protocol version: minor-version
MSB	Most Significant Bit
MSN	Manufacturer's model name of a Type 26 node

M_SZ	Message-data-size in the virtual-address-space
M_RLT	Message result
NDN	Node name of Type 26 node
OSI	Open Systems Interconnect
PDU	Protocol data unit
PhL	Ph-layer
PTP	Point-to-Point
P_TYPE	Protocol-type
RCT	Allowable-refresh-cycle-time
Req	Request
RMT	Refresh-cycle-measurement-time
Rsp	Response
RT	Real Time
SA	Source-address
SAP	Service access point
SDU	Service data unit
SEQ	Sequence-number
SNA	Source-node-number
TCD	Transaction code
TCP	Transmission Control Protocol
TW	Token-watchdog
UDP	User Datagram protocol
ULS	Upper layer status
VDN	Vendor code of the node
V_SEQ	Version of sequence number

3.4 Conventions

3.4.1 Overview

The FAL is defined as a set of object-oriented ASEs. Each ASE is specified in a separate subclause. Each ASE specification is composed of two parts, its class specification, and its service specification.

The class specification defines the attributes of the class. The attributes are accessible from instances of the class using the ASE services specified in 6.5 of this document. The service specification defines the services that are provided by the ASE.

3.4.2 General conventions

This document uses the descriptive conventions given in ISO/IEC 10731.

3.4.3 Conventions for class definitions

Class definitions are described using templates. Each template consists of a list of attributes and services for the class. The general form of the template is shown below:

FAL ASE:			**ASE Name**
CLASS:			**Class Name**
CLASS ID:			**#**
PARENT CLASS:			**Parent Class Name**
ATTRIBUTES:			
1	(o)	Key Attribute:	numeric identifier
2	(o)	Key Attribute:	name
3	(m)	Attribute:	attribute name (values)
4	(m)	Attribute:	attribute name (values)
4.1	(s)	Attribute:	attribute name (values)
4.2	(s)	Attribute:	attribute name (values)
4.3	(s)	Attribute:	attribute name (values)
5	(c)	Constraint:	constraint expression
5.1	(m)	Attribute:	attribute name (values)
5.2	(o)	Attribute:	attribute name (values)
6	(m)	Attribute:	attribute name (values)
6.1	(s)	Attribute:	attribute name (values)
6.2	(s)	Attribute:	attribute name (values)
SERVICES:			
1	(o)	OpsService:	service name
2	(c)	Constraint:	constraint expression
2.1	(o)	OpsService:	service name
3	(m)	MgtService:	service name

a) The "FAL ASE:" entry is the name of the FAL ASE that provides the services for the class being specified.

b) The "CLASS:" entry is the name of the class being specified. All objects defined using this template are an instance of this class. The class may be specified by this document, or by a user of this document.

c) The "CLASS ID:" entry is a number that identifies the class being specified. This number is unique within the FAL ASE that provides the services for this class. When qualified by the identity of its FAL ASE, it unambiguously identifies the class within the scope of the FAL. The value "NULL" indicates that the class cannot be instantiated. Class IDs between 1 and 255 are reserved by this document to identify standardized classes. They have been assigned to maintain compatibility with existing national standards. CLASS IDs between 256 and 2 048 are allocated for identifying user defined classes.

d) The "PARENT CLASS:" entry is the name of the parent class for the class being specified. All attributes defined for the parent class and inherited by it are inherited for the class being defined, and therefore do not have to be redefined in the template for this class.

NOTE The parent-class "TOP" indicates that the class being defined is an initial class definition. The parent class TOP is used as a starting point from which all other classes are defined. The use of TOP is reserved for classes defined by this document.

e) The "ATTRIBUTES" label indicate that the following entries are attributes defined for the class.

   1) Each of the attribute entries contains a line number in column 1, a mandatory (m) / optional (o) / conditional (c) / selector (s) indicator in column 2, an attribute type label in column 3, a name or a conditional expression in column 4, and optionally a list of enumerated values in column 5. In the column following the list of values, the default value for the attribute may be specified.

   2) Objects are normally identified by a numeric identifier or by an object name, or by both. In the class templates, these key attributes are defined under the key attribute.

   3) The line number defines the sequence and the level of nesting of the line. Each nesting level is identified by period. Nesting is used to specify

      i) fields of a structured attribute (4.1, 4.2, 4.3),

      ii) attributes conditional on a constraint statement (5). Attributes may be mandatory (5.1) or optional (5.2) if the constraint is true. Not all optional attributes require constraint statements as does the attribute defined in (5.2),

      iii) the selection fields of a choice type attribute (6.1 and 6.2).

f) The "SERVICES" label indicates that the following entries are services defined for the class.

   1) An (m) in column 2 indicates that the service is mandatory for the class, while an (o) indicates that it is optional. A (c) in this column indicates that the service is conditional. When all services defined for a class are defined as optional, at least one has to be selected when an instance of the class is defined.

   2) The label "OpsService" designates an operational service (1).

   3) The label "MgtService" designates a management service (2).

   4) The line number defines the sequence and the level of nesting of the line. Each nesting level is identified by period. Nesting within the list of services is used to specify services conditional on a constraint statement.

3.4.4 Conventions for service definitions

3.4.4.1 General

The service model, service primitives, and time-sequence diagrams used are entirely abstract descriptions. Therefore, they do not represent a specification for implementation.

3.4.4.2 Service parameters

Service primitives, used to represent service user/service provider interactions (see ISO/IEC 10731), convey parameters that indicate information available in the user/provider interaction. In any particular interface, not all parameters need be explicitly stated.

This document uses a tabular format to describe the component parameters of the service primitives. The parameters that apply to each group of service primitives are set out in tables throughout the remainder of this document. Each table consists of up to five columns, containing the name of the service parameter, and a column each for those primitives and parameter-transfer directions used by the service:

a) parameter name,

b) request primitive (transmitted from the sender),

c) indication primitive (transmitted to the receiver),

d) response primitive (transmitted from the receiver), and

e) confirm primitive (transmitted to the sender).

One parameter (or part of it) is listed in each row of each table. Under the appropriate service primitive columns, a code is used to specify the type of usage of the parameter on the primitive and parameter direction specified in the column:

M parameter is mandatory for the primitive

U parameter is a User option, and can be provided or not depending on the dynamic usage of the service-user. When not provided, a default value for the parameter is assumed.

C parameter is conditional upon other parameters or upon the environment of the service-user.

(blank) parameter is never present.

S parameter is a selected item.

Some entries are further qualified by items in brackets. These may be

1) a parameter-specific constraint:

   "(=)" indicates that the parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table, and

2) an indication that some note applies to the entry:

   "(n)" indicates that the following note "n" contains additional information pertaining to the parameter and its use.

3.4.4.3 Service procedures

The procedures are defined in terms of:

- the interactions between application entities through the exchange of fieldbus Application Protocol Data Units, and
- the interactions between an application layer service provider and an application layer service user in the same system through the invocation of application layer service primitives.

These procedures are applicable to instances of communication between systems which support time-constrained communications services within the FAL.

4 Concepts

The FAL is defined as a set of object-oriented ASEs. Each ASE is specified in a separate subclause. Each ASE specification is composed of three parts: the class definitions, the services and the protocol specification. The first two are contained in this document. The protocol specification for each of the ASEs is defined in IEC 61158-6-26.

The fundamental concepts and templates used to describe the application layer service in this document follow IEC 61158-1, Clause 1.

The FAL defined in this document identifies a peer-based controller communications network supporting a Common-memory model in 6.4 as well as client/server models.

5 Data type ASE

5.1 Overview

Fieldbus data types specify the machine independent syntax for application data conveyed by FAL services. The FAL supports the definition and transfer of both basic and constructed data types. Basic types are atomic types. Constructed types are types composed of basic types and other constructed types.