IEC 61158-3-24

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Industrial communication networks – Fieldbus specifications – Part 3-24: Data-link layer service definition – Type-24 elements

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 3-24: Définition des services de la couche liaison de données – Éléments de type 24

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CONTENTS

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-24: Data-link layer service definition – Type-24 elements

FOREWORD

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

International Standard IEC 61158-3-24 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

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

FDIS	Report on voting
65C/759/FDIS	65C/769/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 the ISO/IEC Directives, Part 2.

A 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.

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- withdrawn,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.

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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 61158-1.

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 data-link layer service defined in this standard is a conceptual architectural service, independent of administrative and implementation divisions.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-24: Data-link layer service definition – Type-24 elements

1 Scope

1.1 General

This part of IEC 61158 provides common elements for basic time-critical messaging communications between devices in an automation environment. 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 defines in an abstract way the externally visible service provided by the Type 24 fieldbus data-link layer in terms of

a) the primitive actions and events of the service;
b) the interrelationship between these actions and events, and their valid sequences;
c) the parameters associated with each primitive action and event, and the form which they take.

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

– the Type 24 fieldbus application layer at the boundary between the application and data-link layers of the fieldbus reference model;
– systems management at the boundary between the data-link layer and systems management of the fieldbus reference model.

1.2 Specifications

The principal objective of this standard is to specify the characteristics of conceptual data-link layer services suitable for time-critical communications, and thus supplement the OSI Basic Reference Model in guiding the development of data-link protocols for time-critical communications. A secondary objective is to provide migration paths from previously-existing industrial communications protocols.

This specification may be used as the basis for formal DL-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 standard does not specify individual implementations or products, nor does it constrain the implementations of data-link entities within industrial automation systems.

There is no conformance of equipment to this data-link layer service definition standard. Instead, conformance is achieved through implementation of the corresponding data-link protocol that fulfills the Type 24 data-link layer services defined in this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 IEC 61784-1 and IEC 61784-2 are maintained simultaneously. Cross-references to these documents within the text therefore refer to the editions as dated in this list of normative references.

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

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

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

ISO/IEC 19501:2005, *Information technology – Open Distributed Processing – Unified Modeling Language (UML) Version 1.4.2*

3 Terms, definitions, symbols, abbreviations and conventions

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

3.1 Reference model terms and definitions

This standard is based in part on the concepts developed in ISO/IEC 7498-1 and ISO/IEC 7498-3 and makes use of the following terms defined therein.

3.1.1 acknowledgement [ISO/IEC 7498-1]

3.1.2 correspondent (N)-entities
correspondent DL-entities (N=2)
correspondent Ph-entities (N=1) [ISO/IEC 7498-1]

3.1.3 DL-address [ISO/IEC 7498-3]

3.1.4 DL-protocol [ISO/IEC 7498-1]

3.1.5 DL-protocol-data-unit [ISO/IEC 7498-1]

3.1.6 DL-service-data-unit [ISO/IEC 7498-1]

3.1.7 DLS-user [ISO/IEC 7498-1]

3.1.8 DLS-user-data [ISO/IEC 7498-1]

3.1.9 event [ISO/IEC 19501]

3.1.10 layer-management [ISO/IEC 7498-1]

3.1.11 rimitive name [ISO/IEC 7498-1]

3.1.12 reset [ISO/IEC 7498-1]

3.1.13 segmenting [ISO/IEC 7498-1]

3.1.14 state [ISO/IEC 19501]

3.1.15 state machine [ISO/IEC 19501]

3.1.16 systems-management [ISO/IEC 7498-1]

3.1.17 transition [ISO/IEC 19501]

3.1.18 (N)-entity [ISO/IEC 7498-1]
DL-entity(N=2)
Ph-entity (N=1)

3.1.19 (N)-layer [ISO/IEC 7498-1]
DL-layer (N=2)
Ph-layer (N=1)

3.1.20 (N)-service [ISO/IEC 7498-1]
DL-service (N=2)
Ph-service (N=1)

3.1.21 (N)-service-access-point [ISO/IEC 7498-1]
DL-service-access-point (N=2)
Ph-service-access-point (N=1)

3.2 Service convention terms and definitions

This standard also makes use of the following terms defined in ISO/IEC 10731 as they apply to the data-link layer:

3.2.1 confirm (primitive)

3.2.2 DL-service-primitive; primitive

3.2.3 DL-service-provider

3.2.4 DL-service-user

3.2.5 indication (primitive)

3.2.6 request (primitive)

3.2.7 requestor

3.2.8 response (primitive)

3.3 Additional Type 24 data-link specific definitions

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

3.3.1
acknowledge
acknowledgement

3.3.2
acyclic transmission
non-periodic exchange of telegrams

3.3.3
C1 master
one of the station type that initiates and control cyclic transmission

3.3.4
C1 message
message communication that C1 master operates as initiator to exchange messages with slave or C2 master

3.3.5
C2 master
one of the station type that has the function of monitoring all process data transmitted through the network and may initiates message communication

3.3.6
C2 message
message communication that C2 master operates as initiator to exchange messages with slave or C1 master

3.3.7
cyclic transmission
periodic exchange of telegrams

3.3.8
data
generic term used to refer to any information carried over a fieldbus

3.3.9
device

physical entity connected to the fieldbus composed of at least one communication element (the network element) and which may have a control element and/or a final element (transducer, actuator, etc.)

3.3.10
event driven mode
transmission mode for the application layer protocol of the communication type 24 in which a transaction of command-response-exchanging arises as user's demands

3.3.11
frame
synonym for DLPDU

3.3.12
initiator
station that initiates the exchange of process data or message

3.3.13
interface
shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics as appropriate

3.3.14
input data
process data sent by the slave and received by the C1 master

3.3.15
message
ordered series of octets intended to convey information

Note 1 to entry: Normally used to convey information between peers at the application layer.

3.3.16
monitor slave
slave that has the function of monitoring all process data transmitted through the network

3.3.17
network
set of nodes connected by some type of communication medium, including any intervening repeaters, bridges, routers and lower-layer gateways

3.3.18
node
a) single DL-entity as it appears on one local link

b) end-point of a link in a network or a point at which two or more links meet

3.3.19
output data
process data sent by the C1 master and received by the slaves

3.3.20
protocol
convention about the data formats, time sequences, and error correction in the data exchange of communication systems

3.3.21
real-time communication
transfer of data in real-time

3.3.22
receiving DLS-user
DL-service user that acts as a recipient of DL-user-data

Note 1 to entry: A DL-service user may be concurrently both a sending and receiving DLS-user.

3.3.23
responder
station that responds process data or message after it has been initiated by initiator

3.3.24
send data with acknowledge
data transfer service with acknowledge of reception from corresponding DLE

3.3.25
send data with no-acknowledge
data transfer service without acknowledge of reception from corresponding DLE

3.3.26
slave
one of the station type that accesses the medium only after it has been initiated by C1-Maser or C2 Master

3.3.27
sending DLS-user
DL-service user that acts as a source of DL-user-data

3.3.28
station
node

3.3.29
topology
physical network architecture with respect to the connection between the stations of the communication system

3.3.30
transmission cycle
fixed time period of cyclic transmission

3.3.31
time slot
time period reserved so that initiator and responder may exchange one frame respectively

3.4 Common symbols and abbreviations

3.4.1	**DA**	Destination address
3.4.2	**DL-**	Data-link layer (as a prefix)
3.4.3	**DLE**	DL-entity (the local active instance of the data-link layer)
3.4.4	**DLL**	DL-layer
3.4.5	**DLM**	DL-management
3.4.6	**DLMS**	DL-management service
3.4.7	**DLPDU**	DL-protocol-data-unit
3.4.8	**DLS**	DL-service
3.4.9	**DLSAP**	DL-service-access-point
3.4.10	**DLSDU**	DL-service-data-unit
3.4.11	**FIFO**	First-in first-out (queuing method)
3.4.12	**ID**	Identifier
3.4.13	**OSI**	Open systems interconnection
3.4.14	**PDU**	Protocol data unit
3.4.15	**Ph-**	Physical layer (as a prefix)
3.4.16	**PhE**	Ph-entity (the local active instance of the physical layer)
3.4.17	**PhL**	Ph-layer
3.4.18	**PHY**	Physical layer device (specified in ISO/IEC 8802-3)
3.4.19	**QoS**	Quality of service
3.4.20	**RT**	Real-time
3.4.21	**SAP**	Service access point
3.4.22	**SDU**	Service data unit

3.5 Additional type 24 symbols and abbreviations

3.5.1	**ACK**	Acknowledge
3.5.2	**C1MSG**	C1 message
3.5.3	**C2MSG**	C2 message
3.5.4	**I/O**	Input and/or output
3.5.5	**MSG**	Message
3.5.6	**Rx**	Receive
3.5.7	**SDA**	Send data with acknowledge
3.5.8	**SDN**	Send data with no-acknowledge
3.5.9	**SM**	State machine
3.5.10	**Tcycle**	Transmission cycle
3.5.11	**Tslot**	Time slot
3.5.12	**Tx**	Transmit

3.6 Common conventions

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

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

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.

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

- the request primitive's input parameters;
- the indication primitive's output parameters;
- the response primitive's input parameters; and
- the confirm primitive's output parameters.

NOTE The request, indication, response and confirm primitives are also known as requestor.submit acceptor.deliver, acceptor.submit, and requestor.deliver primitives, respectively (see ISO/IEC 10731).

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 may or may not be provided depending on the dynamic usage of the DLS-user. When not provided, a default value for the parameter is assumed.