

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 4-4: Spécification du protocole de la couche liaison de données –
Éléments de type 4**

<https://standards.iteh.ai/iec/61158-4-4-2007>

<https://standards.iteh.ai/Catalogue/standards/iec/1e92b6d8-1209-416e-b35f-243e8bb37c00/iec-61158-4-4-2007>



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.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

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

About IEC publications

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

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

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

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 60 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

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

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

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 60 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

**Réseaux de communication industriels – Spécifications des bus de terrain –
Partie 4-4: Spécification du protocole de la couche liaison de données –
Éléments de type 4**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 25.04.40; 35.100.20; 35.110

ISBN 978-2-8322-2793-0

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
1.1 General.....	7
1.2 Specifications.....	7
1.3 Procedures.....	7
1.4 Applicability.....	7
1.5 Conformance.....	7
2 Normative references.....	8
3 Terms, definitions, symbols and abbreviations.....	8
3.1 Reference model terms and definitions.....	8
3.2 Service convention terms and definitions.....	10
3.3 Terms and definitions.....	11
3.4 Symbols and abbreviations.....	14
4 Data Link Protocol Definition.....	14
4.1 Overview of the DL-protocol.....	14
4.2 General structure and encoding of PhPDUs and DLPDUs, and related elements of procedure.....	26
4.3 DLPDU-specific structure, encoding and elements of procedure.....	33
4.4 DL-service elements of procedure.....	37
4.5 Route mechanism.....	40
4.6 Link-access system.....	43
4.7 Local variables, counters and queues.....	44
Bibliography.....	46
Figure 1 – Relationship of PhE, DLE and DLS-user.....	15
Figure 2 – DLE state diagram for confirmed and unconfirmed, unacknowledged DLPDUs.....	17
Figure 3 – DLE state diagram for confirmed acknowledged DLPDUs.....	18
Figure 4 – DLE state diagram for unconfirmed acknowledged DLPDUs.....	19
Figure 5 – Full duplex DLE receive state diagram.....	20
Figure 6 – Full duplex DLE transmit state diagram.....	20
Figure 7 – Link access example.....	23
Figure 8 – Simple Type 4-route format.....	29
Figure 9 – Extended Type 4-route format.....	29
Figure 10 – Complex Type 4-route format.....	30
Figure 11 – Immediate Type 4-route format.....	30
Figure 12 – IP Type 4-route format.....	31
Figure 13 – Control-status format.....	32
Figure 14 – Data-field-format.....	32
Figure 15 – Source / destination designator.....	41
Figure 16 – Simple Type 4-route generation.....	41
Figure 17 – Extended Type 4-route generation.....	42
Figure 18 – Complex and IP Type 4-route generation.....	42

Figure 19 – Simple DL-route generation.....	43
Figure 20 – Extended DL-route generation.....	43
Figure 21 – Complex and IP DL-route generation.....	43
Table 1 – Summary structure of DLPDUs.....	33
Table 2 – Structure of Confirmed DLPDUs.....	34
Table 3 – Structure of Unconfirmed DLPDUs.....	35
Table 4 – Structure of Acknowledge DLPDU.....	36
Table 5 – Structure of Immediate-reply DLPDU.....	36

Withdrawing

iTech Standards
(<https://standards.itih.ai>)
Document Preview

IEC 61158-4-4:2007
<https://standards.itih.ai/Catalogue/standards/iec/1e92b6d8-1209-416e-b35f-243e8bb37c00/iec-61158-4-4-2007>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 4-4: Data-link layer protocol specification – Type 4 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 61158-4-4 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 61158-4 subseries cancel and replace IEC 61158-4:2003. This edition of this part constitutes a minor revision. This part and its companion Type 4 parts also cancel and replace IEC PAS 62412, published in 2005.

This edition of IEC 61158-4 includes the following significant changes from the previous edition:

- a) deletion of the former Type 6 fieldbus, and the placeholder for a Type 5 fieldbus data link layer, for lack of market relevance;
- b) addition of new types of fieldbuses;

c) division of this part into multiple parts numbered -4-1, -4-2, ..., -4-19.

This bilingual version (2015-07) corresponds to the English version, published in 2007-12.

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

FDIS	Report on voting
65C/474/FDIS	65C/485/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.

The French version of this standard has not been voted upon.

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 data-link protocol provides the data-link service by making use of the services available from the physical 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 data-link entities (DLEs) 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:

- a) as a guide for implementors and designers;
- b) for use in the testing and procurement of equipment;
- c) as part of an agreement for the admittance of systems into the open systems environment;
- d) 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.

iTech Standards
(<https://standards.itih.ai>)
Document Preview

IEC 61158-4-4:2007

<https://standards.itih.ai/Catalogue/standards/iec/1e92b6d8-1209-416e-b35f-243e8bb37c00/iec-61158-4-4-2007>

WITHDRAWN

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-4: Data-link layer protocol specification – Type 4 elements

1 Scope

1.1 General

The data-link layer provides basic time-critical messaging communications between devices in an automation environment.

This protocol provides a means of connecting devices through a partial mesh network, such that most failures of an interconnection between two devices can be circumvented. In common practice the devices are interconnected in a non-redundant hierarchical manner reflecting application needs.

1.2 Specifications

This standard specifies

- a) procedures for the timely transfer of data and control information from one data-link user entity to a peer user entity, and among the data-link entities forming the distributed data-link service provider;
- b) the structure of the fieldbus DLPDUs used for the transfer of data and control information by the protocol of this standard, and their representation as physical interface data units.

1.3 Procedures

The procedures are defined in terms of

- a) the interactions between peer DL-entities (DLEs) through the exchange of fieldbus DLPDUs;
- b) the interactions between a DL-service (DLS) provider and a DLS-user in the same system through the exchange of DLS primitives;
- c) the interactions between a DLS-provider and a Ph-service provider in the same system through the exchange of Ph-service primitives.

1.4 Applicability

These procedures are applicable to instances of communication between systems which support time-critical communications services within the data-link layer of the OSI or fieldbus reference models, and which require the ability to interconnect in an open systems interconnection environment.

Profiles provide a simple multi-attribute means of summarizing an implementation's capabilities, and thus its applicability to various time-critical communications needs.

1.5 Conformance

This standard also specifies conformance requirements for systems implementing these procedures. This standard does not contain tests to demonstrate compliance with such requirements.

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 61158-2 (Ed.4.0), *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-3-4, *Industrial communication networks – Fieldbus specifications – Part 3-4: Data-link layer service definition – Type 4 elements*

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*

3 Terms, definitions, symbols and abbreviations

For the purposes of this document, the following terms, definitions, symbols and abbreviations 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 called-DL-address	[7498-3]
3.1.2 calling-DL-address	[7498-3]
3.1.3 centralized multi-end-point-connection	[7498-1]
3.1.4 correspondent (N)-entities	[7498-1]
correspondent DL-entities (N=2)	
correspondent Ph-entities (N=1)	
3.1.5 demultiplexing	[7498-1]
3.1.6 DL-address	[7498-3]
3.1.7 DL-address-mapping	[7498-1]
3.1.8 DL-connection	[7498-1]
3.1.9 DL-connection-end-point	[7498-1]
3.1.10 DL-connection-end-point-identifier	[7498-1]
3.1.11 DL-connection-mode transmission	[7498-1]
3.1.12 DL-connectionless-mode transmission	[7498-1]
3.1.13 DL-data-sink	[7498-1]

3.1.14 DL-data-source	[7498-1]
3.1.15 DL-duplex-transmission	[7498-1]
3.1.16 DL-facility	[7498-1]
3.1.17 DL-local-view	[7498-3]
3.1.18 DL-name	[7498-3]
3.1.19 DL-protocol	[7498-1]
3.1.20 DL-protocol-connection-identifier	[7498-1]
3.1.21 DL-protocol-control-information	[7498-1]
3.1.22 DL-protocol-data-unit	[7498-1]
3.1.23 DL-protocol-version-identifier	[7498-1]
3.1.24 DL-relay	[7498-1]
3.1.25 DL-service-connection-identifier	[7498-1]
3.1.26 DL-service-data-unit	[7498-1]
3.1.27 DL-simplex-transmission	[7498-1]
3.1.28 DL-subsystem	[7498-1]
3.1.29 DL-user-data	[7498-1]
3.1.30 flow control	[7498-1]
3.1.31 layer-management	[7498-1]
3.1.32 multiplexing	[7498-3]
3.1.33 naming-(addressing)-authority	[7498-3]
3.1.34 naming-(addressing)-domain	[7498-3]
3.1.35 naming-(addressing)-subdomain	[7498-3]
3.1.36 (N)-entity DL-entity Ph-entity	[7498-1]
3.1.37 (N)-interface-data-unit DL-service-data-unit (N=2) Ph-interface-data-unit (N=1)	[7498-1]
3.1.38 (N)-layer DL-layer (N=2) Ph-layer (N=1)	[7498-1]
3.1.39 (N)-service DL-service (N=2) Ph-service (N=1)	[7498-1]
3.1.40 (N)-service-access-point DL-service-access-point (N=2) Ph-service-access-point (N=1)	[7498-1]

3.1.41 (N)-service-access-point-address	[7498-1]
DL-service-access-point-address (N=2)	
Ph-service-access-point-address (N=1)	
3.1.42 peer-entities	[7498-1]
3.1.43 Ph-interface-control-information	[7498-1]
3.1.44 Ph-interface-data	[7498-1]
3.1.45 primitive name	[7498-3]
3.1.46 reassembling	[7498-1]
3.1.47 recombining	[7498-1]
3.1.48 reset	[7498-1]
3.1.49 responding-DL-address	[7498-3]
3.1.50 routing	[7498-1]
3.1.51 segmenting	[7498-1]
3.1.52 sequencing	[7498-1]
3.1.53 splitting	[7498-1]
3.1.54 synonymous name	[7498-3]
3.1.55 systems-management	[7498-1]

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 acceptor
3.2.2 asymmetrical service
3.2.3 confirm (primitive); requestor.deliver (primitive)
3.2.4 deliver (primitive)
3.2.5 DL-confirmed-facility
3.2.6 DL-facility
3.2.7 DL-local-view
3.2.8 DL-mandatory-facility
3.2.9 DL-non-confirmed-facility
3.2.10 DL-provider-initiated-facility
3.2.11 DL-provider-optional-facility
3.2.12 DL-service-primitive; primitive
3.2.13 DL-service-provider

3.2.14 DL-service-user**3.2.15 DL-user-optional-facility****3.2.16 indication (primitive)
acceptor.deliver (primitive)****3.2.17 multi-peer****3.2.18 request (primitive);
requestor.submit (primitive)****3.2.19 requestor****3.2.20 response (primitive);
acceptor.submit (primitive)****3.2.21 submit (primitive)****3.2.22 symmetrical service****3.3 Terms and definitions****3.3.1****broadcast-Node-address**

address used to send broadcasts to all DLEs on a Link

NOTE All DLEs on a Link receive all DLPDUs where the first Node-address is equal to the Broadcast-Node-Address. Such DLPDUs are always Unconfirmed, and their receipt is never acknowledged. The value of a Broadcast-Node-address is 126.

3.3.2**destination-DL-route**

holds a sequence of DL-route-elements, describing the complete route to the destination

NOTE This includes both the destination DLSAP and a local component meaningful to the destination DLS-user.

3.3.3**DL-route**

combination of a Destination-DL-route and a Source-DL-route

3.3.4**DL-route element**

octet holding a Node-address or an address used by the DLS-user

3.3.5**DL-segment, link, local link**

single DL-subnetwork in which any of the connected DLEs may communicate directly, without any intervening DL-relaying, whenever all of those DLEs that are participating in an instance of communication are simultaneously attentive to the DL-subnetwork during the period(s) of attempted communication.

3.3.6**DLSAP**

distinctive point at which DL-services are provided by a single DL-entity to a single higher-layer entity.

NOTE This definition, derived from ISO/IEC 7498-1, is repeated here to facilitate understanding of the critical distinction between DLSAPs and their DL-addresses.

3.3.7**DL(SAP)-address**

an individual DLSAP-address, designating a single DLSAP of a single DLS-user

3.3.8

(individual) DLSAP-address

DL-address that designates only one DLSAP within the extended link

NOTE A single DL-entity may have multiple DLSAP-addresses associated with a single DLSAP.

3.3.9

frame

denigrated synonym for DLPDU

3.3.10

IPNetID

identification of a unique IP network. The value of IPNetID shall be in the range of 0-127. The values 0, 126 and 127 are reserved for special purposes

NOTE An IPNetID is translated into an IP-address and a UDP port number.

3.3.11

IPNetTable

definition of the relation between IPNetID, IP address, UDP port number and Router NodeAddress, where IPNetID is used as index in the table

3.3.12

IP Range net

is used for local access, where nodes can be accessed directly on the same subnet as the client, or through a local Router where the subnets are configured in the local Router

3.3.13

Nettype

an IP network is of a certain type, a Nettype that can be "Unused", "IP Range net" or "UDP Range net"

3.3.14

no-Confirm-Node-address

address used to indicate that a request or response is Unconfirmed

NOTE The value of a No-Confirm-Node-address is 0.

3.3.15

node

single DL-entity as it appears on one local link

3.3.16

node-address

address which uniquely identifies a DLE on a Link

NOTE The value of a Node-address can be in the range of 0 to 127, with the values 0, 126 and 127 reserved for special purposes.

3.3.17

normal class device

device which replies to requests from other normal class devices, and initiates transmissions

NOTE Such a device can act as a server (responder) and as a client (requestor) - this is also called a peer.

3.3.18

Type 4-route

holds a sequence of Type 4-route-elements

NOTE A Type 4-route is defined as an encoded DL-route, with one of the formats used when transmitting the DLPDU on the Link. The Type 4-route format can be Simple, Extended, Complex, Immediate or IP.