

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 4–22: Data-link layer protocol specification – Type SNpTYPE elements**

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

IEC/PAS 61158-4-22:2009

<https://standards.iteh.ai/catalog/standards/iec/02583a1f-bc66-4807-af80-dd19156296de/iec-pas-61158-4-22-2009>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2009 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

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

About IEC publications

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

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

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 It also gives information on projects, withdrawn and replaced publications.

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

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

- Electropedia: www.electropedia.org

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

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

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

Email: csc@iec.ch

Tel.: +41 22 919 02 11

Fax: +41 22 919 03 00

IEC PAS 61158-4-22:2009

<https://standards.iteh.ai/document/iec/2583a1f-bc66-4807-af80-dd19156296de/iec-pas-61158-4-22-2009>

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

**Industrial communication networks – Fieldbus specifications –
Part 4–22: Data-link layer protocol specification – Type SNpTYPE elements**

IEC/PAS 61158-4-22:2009
<https://standards.iteh.ai/catalog/standards/iec/02583a1f-bc66-4807-af80-dd19156296de/iec-pas-61158-4-22-2009>

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE **XB**

ICS 25.040; 35.100.20

ISBN 978-2-88910-795-7

CONTENTS

FOREWORD.....	6
1 Scope.....	9
1.1 General.....	9
1.2 Specifications.....	9
1.3 Procedures.....	9
1.4 Applicability.....	9
1.5 Conformance.....	10
2 Normative references	10
3 Terms, definitions, symbols, abbreviations and conventions	10
3.1 Reference model terms and definitions.....	10
3.2 Service convention terms and definitions.....	12
3.3 Common terms and definitions	13
3.4 Additional Type SNpTYPE definitions	14
3.5 Common symbols and abbreviations	16
3.6 Additional Type SNpTYPE symbols and abbreviations.....	17
3.7 Conventions	20
3.7.1 Abstract syntax conventions	20
3.7.2 Protocol machine description conventions	20
4 DL-protocol overview.....	20
4.1 Operating principle	20
4.2 Communication model.....	21
4.2.1 Overview	21
4.2.2 RTFL device reference model.....	21
4.2.3 RTFN device reference model	22
4.3 Topology	23
4.3.1 RTFL topology.....	23
4.3.2 RTFN topology	23
4.4 Frame processing.....	23
4.4.1 Communication model RTFL.....	23
4.4.2 Communication model RTFN	23
4.5 General communication mechanisms	24
4.5.1 Cyclic data channel (CDC).....	24
4.5.2 Message channel (MSC).....	24
4.6 Gateway.....	24
4.7 Interaction models.....	25
4.7.1 Overview	25
4.7.2 Producer-consumer	25
4.7.3 Publisher-subscriber	25
5 DLPDU structure	25
5.1 Overview	25
5.2 Data types and encoding rules	25
5.2.1 Overview	25
5.2.2 Transfer syntax for bit sequences	25
5.2.3 Unsigned Integer	26
5.2.4 Signed Integer.....	26
5.2.5 Octet Array.....	27

5.3	DLPDU identification	27
5.4	General DLPDU structure	27
5.4.1	Type SNpTYPE frame inside an Ethernet frame	27
5.4.2	Type SNpTYPE frame inside a VLAN tagged Ethernet frame	28
5.4.3	Type SNpTYPE frame inside an UDP datagram	28
5.4.4	Type SNpTYPE frame structure	29
5.5	Communication management DLPDUs	30
5.5.1	Network verification DLPDUs	30
5.5.2	RTFN scan network read DLPDUs	31
5.5.3	Identification data	31
5.5.4	RTFN connection management DLPDU	34
5.5.5	ID data	34
5.5.6	RTFL control DLPDU	35
5.5.7	RTFL configuration DLPDUs	35
5.6	Cyclic data channel (CDC) DLPDUs	36
5.6.1	Cyclic data channel line (CDCL) DLPDU	36
5.6.2	Cyclic data channel network (CDCN) DLPDU	37
5.7	Cyclic data channel (CDC) DLPDU data	37
5.7.1	Cyclic data channel (CDC) DLPDU data arrangement	37
5.7.2	Cyclic data channel (CDC) DLPDU data	37
5.8	Message channel (MSC) DLPDUs	38
5.8.1	Message channel line (MSCL) DLPDU	38
5.8.2	Message channel network (MSCN) DLPDU	39
5.9	Message channel DLPDU data - MSC message transfer protocol (MSC-MTP)	39
5.9.1	Overview	39
5.9.2	MSC-MTP frame	39
5.9.3	MSC-MTP frame data	40
5.9.4	MSC-MTP message data encoding	42
5.10	Time synchronization	42
5.10.1	DelayMeasurement start	42
5.10.2	DelayMeasurement read	43
5.10.3	PCS configuration	43
5.10.4	Time synchronization service	43
6	Telegram timing and DLPDU handling	44
6.1	Communication mechanism	44
6.1.1	Communication model RTFL	44
6.1.2	Communication model RTFN	45
6.2	Device synchronization	46
6.2.1	Communication model RTFL – precise clock synchronization	46
6.2.2	Communication model RTFN	47
7	Type SNpTYPE protocol machines	47
7.1	RTFL device protocol machines	47
7.1.1	Overview	47
7.1.2	PortX protocol machine (PortX PM)	48
7.1.3	Frame handling protocol machine (FHPM)	48
7.1.4	Cyclic data channel line protocol machine (CDCLPM)	50
7.1.5	Message channel line protocol machine (MSCLPM)	52
7.1.6	Message channel message transfer protocol protocol machine (MSC-MTP PM)	54

7.1.7	Net management protocol machine (NMPM)	55
7.1.8	Precise clock synchronization (PCS)	57
7.2	RTFN device protocol machines	60
7.2.1	Overview	60
7.2.2	Cyclic data channel network protocol machine (CDCNPM)	60
7.2.3	Message channel network protocol machine (MSCNPM)	60
7.2.4	Message channel message transfer protocol protocol machine (MSC-MTP PM)	60
7.2.5	Net management protocol machine (NMPM)	61
7.3	Message channel - message transfer protocol (MSC-MTP)	62
7.3.1	Overview	62
7.3.2	MSC-MTP PM	62
Figure 1 – RTFL device reference model		22
Figure 2 – RTFN device reference model		22
Figure 3 – Block diagram of hardware		45
Figure 4 – Frame sequence		45
Figure 5 – Communication relationship RTFN device		46
Figure 6 – Overview RTFL device protocol machines		48
Figure 7 – Protocol machine send DLPDU procedure		49
Figure 8 – Protocol machine receive DLPDU procedure		49
Figure 9 – CDCL send cyclic data sequence		50
Figure 10 – CDCL receive cyclic data sequence		51
Figure 11 – MSCL send sequence		53
Figure 12 – MSCL receive sequence		54
Figure 13 – Network management protocol machine		55
Figure 14 – Net management sequence at system boot up		56
Figure 15 – Initialization sequence ordinary device		57
Figure 16 – PCS configuration sequence		58
Figure 17 – Delay measurement principle		59
Figure 18 – Overview RTFN device protocol machines		60
Figure 19 – CDCN connection setup and release		61
Figure 20 – CDCN unpublish data		62
Figure 21 – Segmentation sequence		63
Figure 22 – Expedited transfer sequence		64
Figure 23 – Toggling from expedited transfer to segmented transfer		64
Figure 24 – Segmentation sequence for broad- or multicast message		65
Table 1 – PDU element definition		20
Table 2 – Conventions for protocol machine description		20
Table 3 – Transfer syntax for bit sequences		26
Table 4 – Transfer syntax for data type Unsignedn		26
Table 5 – Transfer syntax for data type Signedn		27
Table 6 – Type SNpTYPE frame inside an Ethernet frame		27
Table 7 – Type SNpTYPE frame inside a VLAN tagged Ethernet frame		28

Table 8 – Type SNpTYPE frame inside an UDP datagram	29
Table 9 – General structure of a Type SNpTYPE frame	29
Table 10 – DLPDU header structure	30
Table 11 – Network verification prepare DLPDU	30
Table 12 – Network verification environment DLPDU	30
Table 13 – Network verification information DLPDU	30
Table 14 – Network verification acknowledgement DLPDU.....	31
Table 15 – RTFN scan network read request DLPDU.....	31
Table 16 – RTFN scan network read response DLPDU	31
Table 17 – Identification data.....	32
Table 18 – PhyLinkPortX	33
Table 19 – RTF support	33
Table 20 – UseDHCP.....	33
Table 21 – DeviceRole.....	34
Table 22 – RTFN connection management DLPDU	34
Table 23 – CDCN connection still alive DLPDU.....	34
Table 24 – ID data	35
Table 25 – RTFL control DLPDU.....	35
Table 26 – RTFL configuration DLPDU	36
Table 27 – RTFL configuration acknowledgement DLPDU.....	36
Table 28 – CDCL DLPDU.....	37
Table 29 – CDCN DLPDU.....	37
Table 30 – CDC DLPDU data arrangement.....	37
Table 31 – CDC DLPDU data.....	38
Table 32 – MSCL DLPDU.....	38
Table 33 – MSCL control	39
Table 34 – MSCN DLPDU.....	39
Table 35 – MSC-MTP frame structure	40
Table 36 – Address type	40
Table 37 – MSC-MTP Init structure	41
Table 38 – MSC-MTP Init_Fast structure	41
Table 39 – MSC-MTP Send structure.....	41
Table 40 – MSC-MTP Acknowledgement structure.....	42
Table 41 – MSC-MTP Abort structure.....	42
Table 42 – Data structure of a message.....	42
Table 43 – DelayMeasurement start encoding.....	43
Table 44 – DelayMeasurement read encoding.....	43
Table 45 – PCS configuration encoding	43
Table 46 – Time synchronization service request.....	43
Table 47 – Time synchronization service response	44

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 4–22: Data-link layer protocol specification –
Type SNpTYPE 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.

A PAS is a technical specification not fulfilling the requirements for a standard, but made available to the public.

IEC-PAS 61158-4-22 has been processed by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
65C/530/PAS	65C/534/RVD

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single 3-year period, following which it shall be revised to become another type of normative document, or shall be withdrawn.

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.

Withdrawn

iTeh Standards

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

Document Preview

IEC PAS 61158-4-22:2009

<https://standards.iteh.ai/catalog/standards/iec/92583a1f-bc66-4807-af80-dd19156296de/iec-pas-61158-4-22-2009>

INTRODUCTION

This PAS contains an additional profile – SNpTYPE – which may be integrated into a future new edition of the IEC 61158-4 series.

Withdrawing

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

IEC PAS 61158-4-22:2009

<https://standards.iteh.ai/catalog/standards/iec/02583a1f-bc66-4807-af80-dd19156296de/iec-pas-61158-4-22-2009>

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4–22: Data-link layer protocol specification – Type SNpTYPE 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 communication opportunities to all participating data-link entities

- a) in a synchronously-starting cyclic manner, according to a pre-established schedule, and
- b) in a cyclic or acyclic asynchronous manner, as requested each cycle by each of those data-link entities.

Thus this protocol can be characterized as one which provides cyclic and acyclic access asynchronously but with a synchronous restart of each cycle.

1.2 Specifications

This part of IEC 61158-4 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 part of IEC 61158-4, 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 part of IEC 61158-4 also specifies conformance requirements for systems implementing these procedures.

This part of IEC 61158-4 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 61588, *Precision clock synchronization protocol for networked measurement and control system*

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 8802-3:2000, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

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

IEETF RFC 768, *User Datagram Protocol*

IEETF RFC 791, *Internet Protocol*

IEEE 802.1Q, *IEEE Standard for Local and metropolitan area networks – Virtual Bridged Local Area Networks*

3 Terms, definitions, symbols, abbreviations and conventions

3.1 Reference model terms and definitions

This part of IEC 61158-4 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	[7498-1]
3.1.2 DL-address	[7498-3]
3.1.3 DL-address-mapping	[7498-1]
3.1.4 called-DL-address	[7498-3]
3.1.5 calling-DL-address	[7498-3]

3.1.6 DL-connection	[7498-1]
3.1.7 DL-connection-end-point	[7498-1]
3.1.8 DL-connection-end-point-identifier	[7498-1]
3.1.9 DL-connection-mode transmission	[7498-1]
3.1.10 DL-connectionless-mode transmission	[7498-1]
3.1.11 decentralized multi-end-point-connection	[7498-1]
3.1.12 DL-duplex-transmission	[7498-1]
3.1.13 (N)-entity	[7498-1]
DL-entity (N=2)	
Ph-entity (N=1)	
3.1.14 flow control	[7498-1]
3.1.15 (N)-layer	[7498-1]
DL-layer (N=2)	
Ph-layer (N=1)	
3.1.16 layer-management	[7498-1]
3.1.17 DL-local-view	[7498-3]
3.1.18 multi-endpoint-connection	[7498-1]
3.1.19 DL-name	[7498-3]
3.1.20 naming-(addressing)-domain	[7498-3]
3.1.21 peer-entities	[7498-1]
3.1.22 primitive name	[7498-3]
3.1.23 DL-protocol	[7498-1]
3.1.24 DL-protocol-connection-identifier	[7498-1]
3.1.25 DL-protocol-control information	[7498-1]
3.1.26 DL-protocol-data-unit	[7498-1]
3.1.27 DL-protocol-version-identifier	[7498-1]
3.1.28 DL-relay	[7498-1]
3.1.29 reassembling	[7498-1]
3.1.30 reset	[7498-1]

3.1.31 responding-DL-address	[7498-3]
3.1.32 routing	[7498-1]
3.1.33 segmenting	[7498-1]
3.1.34 sequencing	[7498-1]
3.1.35 (N)-service	[7498-1]
DL-service (N=2)	
Ph-service (N=1)	
3.1.36 (N)-service-access-point	[7498-1]
DL-service-access-point (N=2)	
Ph-service-access-point (N=1)	
3.1.37 DL-service-access-point-address	[7498-3]
3.1.38 DL-service-connection-identifier	[7498-1]
3.1.39 DL-service-data-unit	[7498-1]
3.1.40 DL-simplex-transmission	[7498-1]
3.1.41 DL-subsystem	[7498-1]
3.1.42 systems-management	[7498-1]
3.1.43 DL-user-data	[7498-1]

3.2 Service convention terms and definitions

This part of IEC 61158-4 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**