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Einsprüche bis 2010-02-28

Entwurf

**Industrielle Kommunikationsnetze –
Feldbusse –
Ergänzung zu IEC 61158-Reihe für Typ 22 (IEC 65C/561/CDV:2009);
Englische Fassung FprEN 61158-200:2009**

Industrial communication networks –
Fieldbus specifications –
IEC 61158-series TYPE 22 (IEC 65C/561/CDV:2009);
English version FprEN 61158-200:2009

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2009-12-14 wird der Öffentlichkeit zur Prüfung und Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses Entwurfes besonders zu vereinbaren.

Stellungnahmen werden erbeten

- vorzugsweise als Datei per E-Mail an dke@din.de in Form einer Tabelle. Die Vorlage dieser Tabelle kann im Internet unter www.dke.de/stellungnahme abgerufen werden;
- oder in Papierform an die DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (Hausanschrift: Stresemannallee 15, 60596 Frankfurt am Main).

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevante Patentrechte, die sie kennen, mitzuteilen und unterstützende Dokumentationen zur Verfügung zu stellen.

Gesamtumfang 267 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE

Nationales Vorwort

Die englische Fassung des europäischen Dokuments FprEN 61158-200:2009 „Industrielle Kommunikationsnetze – Feldbusse – Ergänzung zu IEC 61158-Reihe für Typ 22“ (Entwurf in der Umfrage) ist unverändert in diesen Norm-Entwurf übernommen worden.

Die Internationale Elektrotechnische Kommission (IEC) und das Europäische Komitee für Elektrotechnische Normung (CENELEC) haben vereinbart, dass ein auf IEC-Ebene erarbeiteter Entwurf für eine Internationale Norm zeitgleich (parallel) bei IEC und CENELEC zur Umfrage (CDV-Stadium) und Abstimmung als FDIS (en: Final Draft International Standard) bzw. Schluss-Entwurf für eine Europäische Norm gestellt wird, um eine Beschleunigung und Straffung der Normungsarbeit zu erreichen. Dem entsprechend ist das internationale Dokument IEC 65C/561/CDV:2009 „Industrial communication networks – Fieldbus specifications – IEC 61158-series TYPE 22“ unverändert in den Entwurf FprEN 61158-200:2009 übernommen worden.

Zur Neuausgabe der Normenreihe IEC 61158 wurden die Entwürfe E DIN EN 61158-300:2009-07, E DIN EN 61158-400:2009-07, E DIN EN 61158-500:2009-7 und E DIN EN 61158-600:2009-07 veröffentlicht. Die IEC beabsichtigt, zu dieser Neuausgabe die Technologie SafetyNet P hinzuzufügen. Die zu dieser Ergänzung notwendigen Inhalte befinden sich in dem vorliegenden Normentwurf.

Das internationale Dokument wurde vom SC 65C „Industrial networks“ der Internationalen Elektrotechnischen Kommission (IEC) erarbeitet.

Bei der Abstimmung zu dem Europäischen Schluss-Entwurf bei CENELEC und dem Internationalen Schluss-Entwurf bei IEC [Final Draft International Standard (FDIS)] sind jeweils nur „JA/NEIN“-Entscheidungen möglich, wobei „NEIN“-Entscheidungen fundiert begründet werden müssen. Dokumente, die bei CENELEC als Europäische Norm angenommen und ratifiziert werden, sind unverändert als Deutsche Normen zu übernehmen.

Für diesen Norm-Entwurf ist das nationale Arbeitsgremium K 956 „Feldbus“ der DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE (www.dke.de) zuständig.

Da sich die Benutzer des vorliegenden Norm-Entwurfs der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN 61158-200 veröffentlicht. Für die meisten der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Norm-Entwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für die vorliegende Norm erfüllt.

Für den Fall einer undatierten Verweisung im normativen Text (Verweisung auf eine Norm ohne Angabe des Ausgabedatums und ohne Hinweis auf eine Abschnittsnummer, eine Tabelle, ein Bild usw.) bezieht sich die Verweisung auf die jeweils neueste gültige Ausgabe der in Bezug genommenen Norm.

Für den Fall einer datierten Verweisung im normativen Text bezieht sich die Verweisung immer auf die in Bezug genommene Ausgabe der Norm.

Der Zusammenhang der zitierten Normen mit den entsprechenden Deutschen Normen ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als EN 60068 als Europäische Norm durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

INCLUDED SUBPARTS

NOTE The Contents of each subpart begins on page 3, so that the page numbering will be unchanged when the final International Standard is issued with its IEC-Central-Office-provided cover sheet.

IEC 61158-3-22	Industrial communication networks – Fieldbus specifications – Part 3-22: Data-link layer service definition – Type 22 elements	22003
IEC 61158-4-22	Industrial communication networks – Fieldbus specifications – Part 4-22: Data-link layer protocol specification – Type 22 elements	22003
IEC 61158-5-22	Industrial communication networks – Fieldbus specifications – Part 5-22: Application layer service definition – Type 22 elements	22003
IEC 61158-6-22	Industrial communication networks – Fieldbus specifications – Part 6-22: Application layer protocol specification – Type 22 elements	22003

The following subpart will be amended as follows with the included document:

IEC TR 61158-1	Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series	
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The following subpart will remain unchanged.

IEC 61158-2,	Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition	
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 3-22: Data-link layer service definition – Type 22 elements**

FOREWORD

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WO-2006/069691-A1	[PI]	CONTROL SYSTEM WITH A PLURALITY OF SPATIALLY DISTRIBUTED STATIONS AND METHOD FOR TRANSMITTING DATA IN SAID CONTROL SYSTEM
DE - 10 2004 063 213 - B4	[PI]	Steuerungssystem mit einer Vielzahl von räumlich verteilten Stationen sowie Verfahren zum Übertragen von Daten in einem solchen Steuerungssystem

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until 2012. At this date, the publication will be

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

The list of all parts of the IEC 61158 series, under the general title *Industrial communication networks – Fieldbus specifications*, can be found on the IEC website.

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.

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 3-22: Data-link layer service definition – Type 22 elements

1 Scope

1.1 Overview

This standard 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 22 fieldbus data-link layer in terms of:

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

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

- the Type 22 fieldbus application layer at the boundary between the application and data-link layers of the fieldbus reference model; and
- 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 do they 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 fulfils the Type 22 data-link layer services defined in this standard.

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.

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

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – Basic Reference Model — 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 8802-3:2000, *Information Technology – Telecommunications and Informations Exchange between Systems – Local and metropolitan Area Networks – Specific Requirements - Carrier Sense Multiple Acces with Collision Detection (CSMA/CD) - Access method and Physical layer Specifications.*

3 Terms, definitions, symbols, abbreviations and conventions

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 DL-address	[7498-3]
3.1.2 called-DL-address	[7498-3]
3.1.3 calling-DL-address	[7498-3]
3.1.4 DL-connection	[7498-1]
3.1.5 DL-connection-end-point	[7498-1]
3.1.6 DL-connection-end-point-identifier	[7498-1]
3.1.7 DL-connection-mode transmission	[7498-1]
3.1.8 DL-connectionless-mode transmission	[7498-1]
3.1.9 correspondent (N)-entities correspondent DL-entities (N=2) correspondent Ph-entities (N=1)	[7498-1]
3.1.10 decentralized multi-end-point-connection	[7498-1]
3.1.11 DL-duplex-transmission	[7498-1]
3.1.12 (N)-entity DL-entity (N=2) Ph-entity (N=1)	[7498-1]
3.1.13 DL-facility	[7498-1]
3.1.14 flow control	[7498-1]
3.1.15 (N)-layer DL-layer (N=2) Ph-layer (N=1)	[7498-1]
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-data-unit	[7498-1]
3.1.26 DL-relay	[7498-1]
3.1.27 reassembling	[7498-1]
3.1.28 reset	[7498-1]
3.1.29 responding-DL-address	[7498-3]
3.1.30 routing	[7498-1]
3.1.31 segmenting	[7498-1]
3.1.32 (N)-service	[7498-1]
DL-service (N=2)	
Ph-service (N=1)	
3.1.33 (N)-service-access-point	[7498-1]
DL-service-access-point (N=2)	
Ph-service-access-point (N=1)	
3.1.34 DL-service-access-point-address	[7498-3]
3.1.35 DL-service-connection-identifier	[7498-1]
3.1.36 DL-service-data-unit	[7498-1]
3.1.37 DL-simplex-transmission	[7498-1]
3.1.38 DL-subsystem	[7498-1]
3.1.39 systems-management	[7498-1]
3.1.40 DL-user-data	[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 Data-link service terms and definitions

3.3.1

acyclic data

data which is transferred from time to time for dedicated purposes

3.3.2

cell

synonym for a single DL-segment which uses RTFL communication model

3.3.3

communication cycle

fixed time period between which the root device issues empty frames for cyclic communication initiation in which data is transmitted utilizing CDC and MSC

3.3.4

cycle time

duration of a communication cycle

3.3.5**cyclic**

events which repeat in a regular and repetitive manner

3.3.6**cyclic communication**

periodic exchange of frames

3.3.7**cyclic data**

data which is transferred in a regular and repetitive manner for dedicated purposes

3.3.8**cyclic data channel (CDC)**

one or more frames, which are reserved for cyclic data

3.3.9**data**

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

3.3.10**device**

physical entity connected to the fieldbus

3.3.11**DL-segment**

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

3.3.12**error**

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

3.3.13**extended link**

DL-subnetwork, consisting of the maximal set of links interconnected by DL-relays, sharing a single DL-name (DL-address) space, in which any of the connected DL-entities may communicate, one with another, either directly or with the assistance of one or more of those intervening DL-relay entities

NOTE An extended link may be composed of just a single link.

3.3.14**frame**

denigrated synonym for DLPDU

3.3.15**gateway**

device acting as a linking element between different protocols

3.3.16**interface**

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

3.3.17

link

synonym for DL-segment

3.3.18

logical double line

sequence of root device and all ordinary devices processing the communication frame in forward and backward direction

3.3.19

master clock

global time base for the PCS mechanism

3.3.20

message

ordered sequence of octets intended to convey data

3.3.21

message channel (MSC)

one or more DPUs (frames), which are reserved for acyclic data

3.3.22

network

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

3.3.23

open network

any network based on IEC 8802.3 with no further restrictions

3.3.24

ordinary device (OD)

slave in the communication system, which utilizes RTFL for cyclic and acyclic data interchange with other ODs in the same logical double line

3.3.25

precise clock synchronization (PCS)

mechanism to synchronize clocks of RTFL devices and maintain a global time base

3.3.26

process data

data designated to be transferred cyclically or acyclically for the purpose of processing

3.3.27

protocol

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

3.3.28

root device (RD)

master in the communication system, which organises, initiates and controls the RTFL cyclic and acyclic data interchange for one logical double line

3.3.29

real time frame line (RTFL)

communication model communicating in a logical double line

3.3.30**real time frame network (RTFN)**

communication model communicating in a switched network

3.3.31**switch**

MAC bridge as defined in IEEE 802.1D

3.3.32**timing signal**

time-based indication of the occurrence of an event, commonly as an interrupt signal, used for DL-user synchronization

3.3.33**topology**

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

3.4 Symbols and abbreviations

CDC	Cyclic data channel
CDCS	Cyclic data channel send
DA	Device address
DL-	Data-link layer (as a prefix)
DLL	DL-layer
DLS	DL-service
DMR	DL-DelayMeasurement read
DMS	DL-DelayMeasurement send
ID	Identification
IP	Internet protocol
IRQ	Interrupt request
MAC	Medium access control
MII	Media independent interface
MIIR	DL-Media independent interface read
MIIW	DL-Media independent interface write
MSC	Message channel
MSCDN	Message channel data notification

MSCR	Message channel read
MSCS	Message channel send
MSCSB	Message channel send broadcast
NV	DL-Network verification
OD	Ordinary device
OSI	Open systems interconnection
PID	Packet ID
PCS	Precise clock synchronization
PCSC	DL-PCS configuration
RD	Root device
RDCD	DL-Read configuration data
RTF	Real time frame
RTFL	Real time frame line
RTFLCFG	DL-RTFL configuration
RTFLCTL	DL-RTFL control
RTFN	Real time frame network
RTFNCE	DL-RTFN connection establishment
RTFNCR	DL-RTFN connection release
RTFNSNR	DL-RTFN Scan network read
SYNC	Synchronization
SYNC_MC	DL-Sync master configuration
SYNC_START	DL-Sync start
SYNC_STOP	DL-Sync stop

3.5 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 request primitive's output 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.
C	parameter is conditional upon other parameters or upon the environment of the DLS-user.
(blank)	parameter is never present.

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

In any particular interface, not all parameters need be explicitly stated. Some may be implicitly associated with the primitive.

In the diagrams which illustrate these interfaces, dashed lines indicate cause-and-effect or time-sequence relationships, and wavy lines indicate that events are roughly contemporaneous.

4 Data-link layer services and concepts

4.1 Operating principle

Type 22 of this series of international standards describes a technology for ISO/IEC 8802-3 based networks which was developed to meet the requirements of automation technology. For the purpose of fast intra-machine communication Type 22 describes a communication model (RTFL) for fast real-time communication. Furthermore, networking of several parts of an automation system into an overall system is supported by the specification of a second

communication model (RTFN). Type 22 is designed as a multi-master bus system to enable networking of individual control systems in a distributed automation solution.

A Type 22 network utilizes standard ISO/IEC 8802-3 DPUs (frames) for both communication models.

4.2 Communication models

4.2.1 Overview

Type 22 technology essentially specifies two communication models. RTFL communication is intended for fast machine communication while RTFN provides for the networking of individual machines or cells.

For RTFL communication model, communication follows a line topology. RTFL communication is based on cyclic data transfer in an ISO/IEC 8802-3 DLPDU . This basic cyclic data transfer is provided by a special device, the root device (RD). Root devices act as communication master to cyclically initiate communication. The DLPDUs originated by the root device are passed to the Type 22 ordinary devices (OD). Each ordinary device receives the frame, writes its data and passes the frame on. A RTFL network requires exactly one root device. The last ordinary device of a RTFL network sends the processed frame back. The frame is transferred back in reverse device order to the root device so that it is returned by the first ordinary device to the root device as response frame. In backward direction, the ordinary devices read their relevant data from the frame.

For RTFN communication model, communication is based on individual point to point connections between participating devices.

4.2.2 RTFL device reference model

Type 22 services are described using the principles, methodology and model of ISO/IEC 7498-1 (OSI). The OSI model provides a layered approach to communications standards, whereby the layers can be developed and modified independently. The Type 22 specification defines functionality from top to bottom of a full OSI model. Functions of the intermediate OSI layers, layers 3 to 6, are consolidated into either the Type 22 data-link layer or the DL-user. The device reference model for a Type 22 RTFL device is shown in Figure 1.

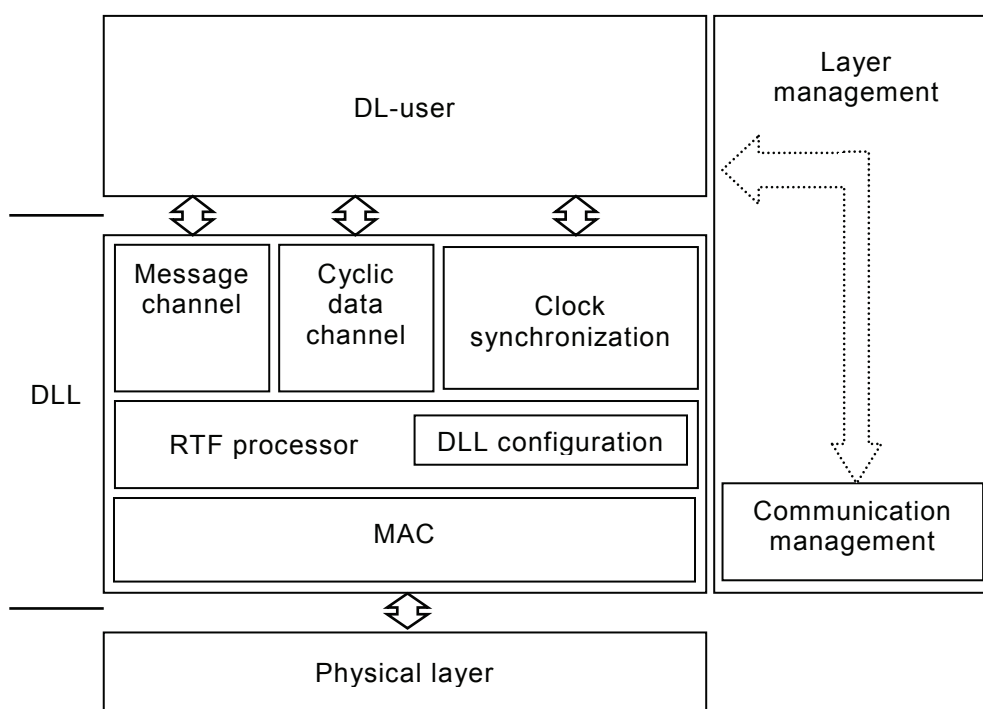


Figure 1 – RTFL device reference model

4.2.3 RTFN device reference model

Type 22 services are described using the principles, methodology and model of ISO/IEC 7498-1 (OSI). The OSI model provides a layered approach to communications standards, whereby the layers can be developed and modified independently. The Type 22 specification defines functionality from top to bottom of a full OSI model. Functions of the intermediate OSI layers, layers 3 to 6, are consolidated into either the Type 22 data-link layer or the DL-user. The device reference model for a Type 22 RTFN device is shown in Figure 2.

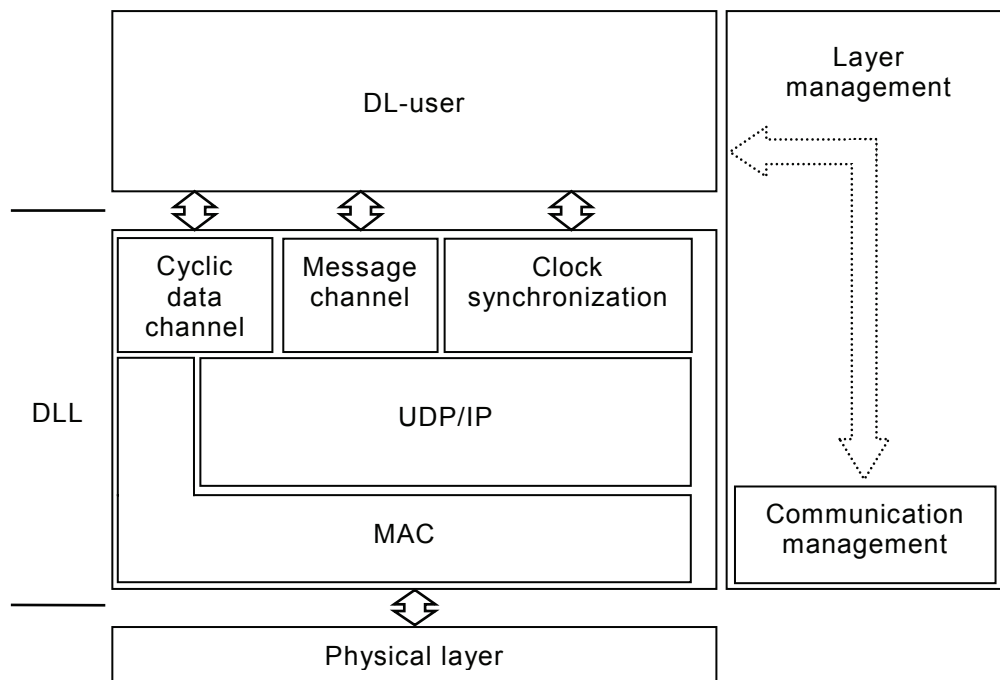


Figure 2 – RTFN device reference model

4.3 Topology

4.3.1 RTFL topology

A Type 22 network utilizing the RTFL communication model uses a logical double line topology. A logical double line is represented by the arrangement of all ordinary devices and the root device and the DLPDU processing in forward and backward direction. Data transfer is handled by DLPDU transfer from one device to the next device along the logical double line. The last ordinary device returns the frame back to the root device along all participating ordinary devices

A logical double line is able to allow different network topologies. In a switch operated tree structure each ordinary device has a predecessor and a successor device although they are not physically located in a sequence. This is shown in Figure 3.

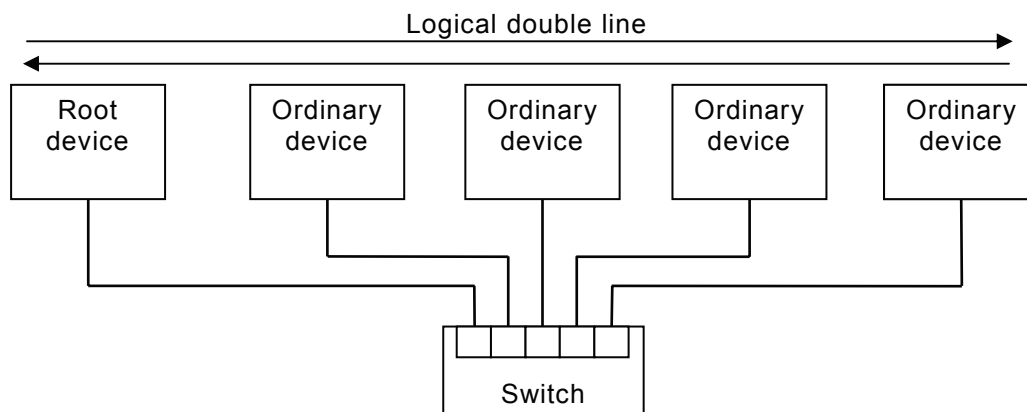


Figure 3 – Logical double line in a physical tree topology

The ordinary devices for the RTFL communication model should provide two ISO/IEC 8802.3 based communication interfaces. This allows set-up of a physical line structure as shown in

Figure 4. If the ordinary devices are arranged in a physical line DLPDUs shall be directly forwarded from one interface to the next interface and processed on-the-fly (cut-through).

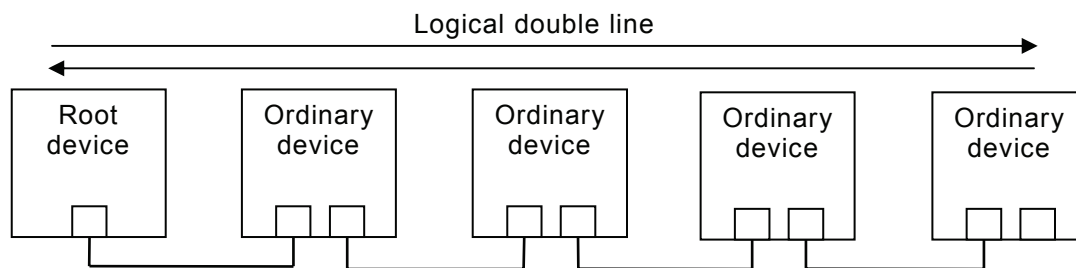


Figure 4 – Logical double line in a physical line topology

For a Type 22 network utilizing the RTFL communication model the frame pump concept is specified. This concept shall be applied by the root device within a RTFL network to cyclically initiate communication. Frame pumping depicts the generation of an RTFL DLDPU into the RTFL network to be processed by all participating ordinary devices for communication purposes.

4.3.2 RTFN topology

A Type 22 network utilizing the RTFN communication model shall support all commonly used topologies like star, tree and line.

4.4 Addressing

4.4.1 Overview

Different addressing modes are supported for Type 22 devices, as noted in Figure 5. A general differentiation exists for RTFL devices and RTFN devices.

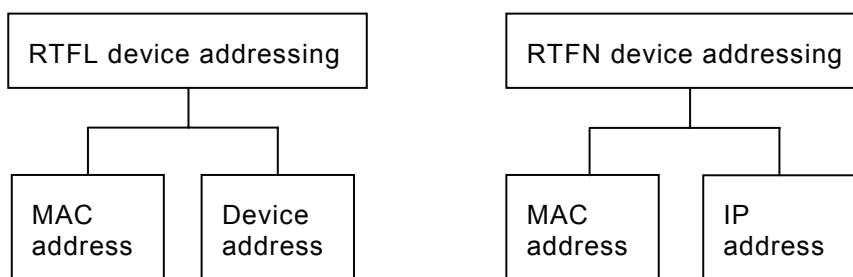


Figure 5 – Addressing modes

4.4.2 RTFL device addressing

MAC addresses as defined in ISO/IEC 8802.3 shall be used to address each device via its MAC address within the logical double line.

Device addresses shall be used to address devices via a configured device address assigned by the root device during the start-up phase. Device addresses shall be used for addressing devices within DL-user communication relationships.

4.4.3 RTFN device addressing

IP addresses as defined in RFC 791 shall be used to address devices within a RTFN network for cyclic or acyclic communication based on UDP DLPDUs (frames).

MAC addresses shall be used to address devices within a RTFN network for cyclic communication based on MAC DLPDUs.

4.5 Gateway

The gateway acts as linking element between RTFL and RTFN networks. In addition, it is a gateway between Type 22 networks and the open network. A device incorporating a gateway can be an ordinary device or can also include the root device. Address translation between the different addressing modes for RTFL and RTFN shall be performed by the gateway.

4.6 Interaction models

4.6.1 Overview

Depending on the specified communication models RTFL and RTFN Type 22 networks utilize different interaction models for cyclic data exchange.

4.6.2 Producer-consumer

Communication model RTFL uses the producer-consumer interaction model. It involves a single producer and a group of zero or more consumer(s). The model is characterized by an unconfirmed service requested by the producer to distribute its cyclic data and a correlated service indication in all available consumers.

4.6.3 Publisher-subscriber

Communication model RTFN utilizes the publisher-subscriber push interaction model for cyclic data exchange. Publisher-subscriber interactions involve a single publisher and a group of one or more subscribers. Two services are used, one confirmed and one unconfirmed. The confirmed service is used by the subscriber to request to join the publishing. The response to this request is returned to the subscriber. The unconfirmed service is used by the publisher to distribute its cyclic data to subscribers.

4.7 Synchronization concept

Clock synchronization within Type 22 networks is based on synchronization protocols. For DL-users, synchronization is achieved by using a set of DL-services.

Synchronization protocols enable all Type 22 devices to have the same system time. This system time is synchronized with a dedicated master clock. Based on this time, the concept of synchronized timing signals (IRQs) that can be generated independent of the communication cycle for DL-users is provided. Each timing signal is unambiguously identifiable within a Type 22 network and assigned to a dedicated synchronization master (SYNC master). The synchronization master shall maintain all required configuration information. DL-users which act as synchronization slaves (SYNC slave) shall request this information for configuration and activation purpose using a DL-service. The main properties of synchronized timing signals are:

- cycle time;
- time offset; and
- start time.

DL-users which act as synchronization master (SYNC master) shall use a local configuration service for the configuration.

Figure 6 illustrates the interactions between a SYNC slave and a SYNC master for configuration data exchange utilizing a time-sequence diagram.

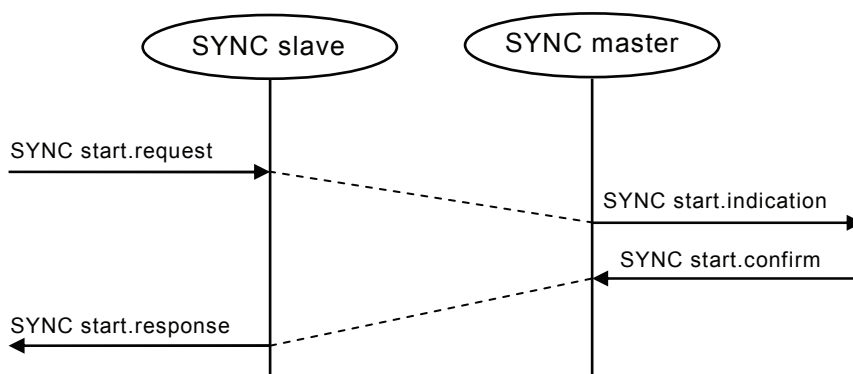


Figure 6 – Time sequence diagram for time SYNC_START service

Figure 7 illustrates the generation of synchronized timing signals (IRQs) for one SYNC slave and its corresponding SYNC master after successful slave configuration. Independent from the communication system synchronized timing signals (IRQs) are generated in both devices to the DL-user.

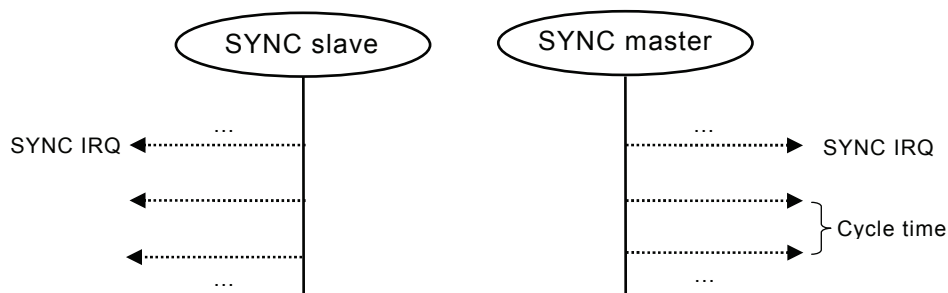


Figure 7 – Synchronized timing signals without offset

Figure 8 illustrates the generation of synchronized timing signals (IRQs) for one SYNC slave and its corresponding SYNC master after successful slave configuration. Independent from the communication system synchronized timing signals (IRQs) are generated in both devices to the DL-user. For the SYNC slave, a time offset relating to the SYNC master timing signal is configured.

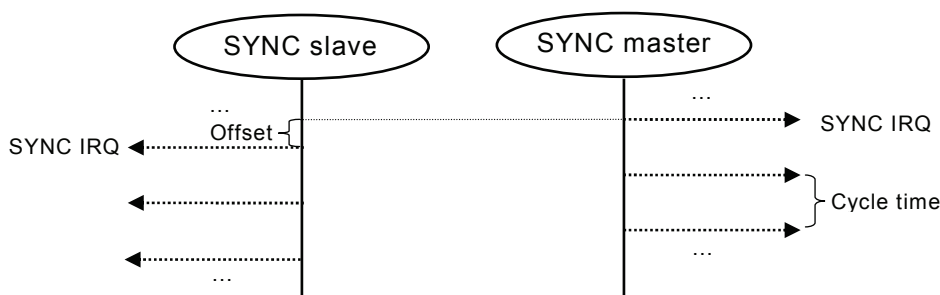


Figure 8 – Synchronized timing signals with offset

5 Communication services

5.1 Overview

The data-link layer specifies Type 22 services for reading and writing data from devices in a Type 22 network (see Table 1). There are four different types of services:

- communication management services (confirmed and unconfirmed, non-cyclic);
- cyclic data channel (CDC) services (unconfirmed, cyclic);
- message channel (MSC) services (confirmed and unconfirmed, non-cyclic);
- time synchronization services (confirmed, non-cyclic).

Table 1 – Summary of DL-services and primitives

Service	Primitive
Acknowledged connection oriented data transfer: Network verification (NV)	DL-NV request DL-NV indication DL-NV response DL-NV confirmation
Acknowledged connection oriented data transfer: RTFN scan network read (RTFNSNR)	DL-RTFNSNR request DL-RTFNSNR indication DL-RTFNSNR response DL-RTFNSNR confirmation
Acknowledged connection oriented data transfer: RTFN connection establishment (RTFNCE)	DL-RTFNCE request DL-RTFNCE indication DL-RTFNCE response DL-RTNFCE confirmation
Unacknowledged connectionless data transfer: RTFN connection release (RTFNCR)	DL-RTFNCR request DL-RTFNCR indication
Unacknowledged connectionless data transfer: RTFL control (RTFLCTL)	DL-RTFLCTL request DL-RTFLCTL indication
Acknowledged connection oriented data transfer: RTFL configuration (RTFLCFG)	DL-RTFLCFG request DL-RTFLCFG indication DL-RTFLCFG response DL-RTFLCFG confirmation
Unacknowledged connectionless data transfer: CDC send (CDCS)	CDCS request CDCS indication
Acknowledged connection oriented data transfer: MSC send (MSCS)	MSCS request MSCS indication MSCS response MSCS confirmation
Unacknowledged connectionless data transfer: MSC send broadcast (MSCSB)	MSCSB request MSCSB indication
Unacknowledged connectionless data transfer: DelayMeasurement start (DMS)	DL-DMS request DL-DMS indication
Acknowledged connection oriented data transfer: DelayMeasurement read (DMR)	DL-DMR request DL-DMR indication DL-DMR response DL-DMR confirmation
Unacknowledged connectionless data transfer: PCS configuration	DL-PCSC request DL-PCSC indication

Service	Primitive
Acknowledged connection oriented data transfer: Sync start (SYNC_START)	DL-SYNC_START request DL-SYNC_START indication DL-SYNC_START response DL-SYNC-START confirmation

5.2 Communication management services

5.2.1 Overview

With communication management services, Type 22 devices perform the initialization of a Type 22 network and connections.

5.2.2 Network verification

5.2.2.1 DL-Network verification service (NV)

With the NV service as specified in Table 2 a DL-user can verify the Type 22 RTFL network against a preset set of participating devices.

Table 2 – DL-Network verification service (NV)

Parameter name	Request input	Indication output	Response input	Confirmation output
Identification data list			M	M (=)
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.				

Parameter description

Identification data list

This parameter shall contain the result of the RTFL network verification. It shall reflect the participating devices by a list consisting of one identification data set for each device.

5.2.2.2 DL-RTFN scan network read service (RTFNSNR)

The RTFNSNR service as specified in Table 3 allows to explore a RTFN network. All participating devices are identified by descriptive identification data.

Table 3 – DL-RTFN scan network read service (RTFNSNR)

Parameter name	Request input	Indication output	Response input	Confirmation output
Identification data list			M	M (=)
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.				

Parameter description

Identification data list

This parameter shall contain the result of the RTFN topology exploration. It shall reflect the participating RTFN devices by a list consisting of one identification data set for each device.

5.2.3 Communication management

5.2.3.1 DL-RTFN connection establishment service (RTFNCE)

With the RTFNCE service as specified in Table 4 a device shall establish its CDC connections to other devices.

Table 4 – DL-RTFN connection establishment DLL service (RTFNCE)

Parameter name	Request input	Indication output	Response input	Confirmation output
Command	M	M (=)		
PID	M	M (=)		
UseUDP	M	M (=)		
Error code			M	M (=)
IP address			M	M (=)
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.				

Parameter description

Command

This parameter shall indicate the connection management function performed for the dedicated CDC connection.

PID

This parameter shall identify the requested process data.

UseUDP

This parameter indicates whether transmission of cyclic data shall use either UDP or MAC frames.

Error code

This parameter shall contain the error code for the performed connection management function.

IP address

This parameter depicts the IP Address of the data publisher.

5.2.3.2 DL-RTFN connection release service (RTFNCR)

With the RTFNCR service as specified in Table 5 a device shall terminates its CDC connections with other devices.

Table 5 – DL-RTFN connection release service (RTFNCR)

Parameter name	Request input	Indication output
Command	M	M (=)

PID	M	M (=)
-----	---	-------

Parameter description

Command

This parameter shall indicate the connection management function performed for the dedicated CDC connection.

PID

This parameter shall identify the process data.

5.2.3.3 DL-RTFL control service (RTFLCTL)

The RTFLCTL service as specified in Table 6 is used by a root device to reset the communication system of participating devices.

Table 6 – DL-RTFL control service (RTFLCTL)

Parameter name	Request input	Indication output
Command	M	M (=)

Parameter description

Command

This parameter contains the reset command.

5.2.3.4 DL-RTFL configuration service (RTFLCFG)

The RTFLCFG service as specified in Table 7 is used by a root device to configure participating devices.

Table 7 – DL-RTFL configuration service (RTFLCFG)

Parameter name	Request input	Indication output	Response input	Confirmation output
Predecessor MAC	M	M (=)		
Successor MAC	M	M (=)		
Successor MAC altern.	M	M (=)		
Device Address	M	M (=)		
MSCSHORTMsgSize	M	M (=)		
Number of frames	M	M (=)		
Cycle time	M	M (=)		
RTF timeout	M	M (=)		
Master clock DA	M	M (=)		
IP configuration	C	C (=)		
Configuration summary			M	M (=)

NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.

Parameter description

Predecessor MAC

This parameter indicates the MAC address of the preceding device within the logical double line.

Successor MAC

This parameter indicates the MAC address of the succeeding device within the logical double line.

Successor MAC alternative

This parameter indicates an alternative MAC address of a succeeding device within the logical double line.

Device address

This parameter indicates the device address which shall be used.

MSCShortMsgSize

This parameter indicates the maximum message size in octets for an un-segmented message transfer using MSC.

Number of frames

This parameter indicates the number of RTF frames used for both possible communication channels.

Cycle time

This parameter indicates the cycle time of the communication cycle.

RTF timeout

This parameter indicates a maximum delay time for the RTFL communication cycle time from the expected communication cycle time.

Master clock DA

This parameter indicates the device address of the device which integrates the master clock.

IP configuration

This parameter indicates IP configuration data.

Configuration summary

This parameter contains a summary of the performed device configuration in terms of state information for the configured parameters.

5.2.3.5 DL-Read configuration data service (RD CD)

The local RD CD service as specified in Table 8 is used by a DL-user to read the DL-configuration.

Table 8 – DL-Read configuration data service (RD CD)

Parameter name	Request input	Indication output	Response input	Confirmation Output
Predecessor MAC			M	M (=)
Successor MAC			M	M (=)
Successor MAC altern.			M	M (=)
Device Address			M	M (=)
MSCShortMsgSize			M	M (=)

Number of frames			M	M (=)
Cycle time			M	M (=)
RTF timeout			M	M (=)
Master clock DA			M	M (=)
IP configuration			C	C (=)
<p>NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.</p>				

Parameter description

Predecessor MAC

This parameter indicates the MAC address of the preceding device within the logical double line.

Successor MAC

This parameter indicates the MAC address of the succeeding device within the logical double line.

Successor MAC alternative

This parameter indicates an alternative MAC address of a succeeding device within the logical double line.

Device address

This parameter indicates the device address which shall be used.

MSCShortMsgSize

This parameter indicates the maximum message size in octets for an un-segmented message transfer using MSC.

Number of frames

This parameter indicates the number of RTF frames used for both possible communication channels.

Cycle time

This parameter indicates the cycle time of the communication cycle.

RTF timeout

This parameter indicates a maximum delay time for the RTFL communication cycle time from the expected communication cycle time.

Master clock DA

This parameter indicates the device address of the device which integrates the master clock.

IP configuration

This parameter indicates IP configuration data.

5.3 Cyclic data channel service (CDC)

5.3.1 Overview

The cyclic data channel (CDC) is intended for cyclic real time data transfer. This mechanism shall be initiated by the DL-user.

5.3.2 CDC send service (CDCS)

With the CDCS service as specified in Table 9 a DL-user shall write the configured cyclic data for the next communication cycle.

Table 9 – CDC send service (CDCS)

Parameter name	Request input	Indication output
PID	M	M (=)
Data	M	M (=)

Parameter description

PID

This parameter shall identify the process data to be sent.

Data

This parameter shall contain the cyclic data which has to be sent.

5.4 Message channel services (MSC)

5.4.1 Overview

The message channel is used for acyclic communication. Data is transferred as variable-length segmented messages. The MSC service is a confirmed service.

5.4.2 MSC send service (MSCS)

A DL-user shall use the MSCS service as specified in Table 10 to send data to a device selected by a device or IP address.

Table 10 – MSC send service (MSCS)

Parameter name	Request input	Indication output	Response input	Confirmation output
Data	M	M (=)		
Destination DA	C	C (=)		
IP address	C	C (=)		
Error code			M	M (=)
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.				

Parameter description

Data

This parameter shall contain the data which is sent to the device.

Destination DA

This parameter shall contain the destination device address

IP Address

This parameter shall contain the IP address (as defined in RFC 791) of the source or destination

Error code

This parameter shall contain the error code for the send request.

5.4.3 MSC send broadcast service (MSCSB)

A DL-user shall use the MSCSB service as specified in Table 11 to send data to all participating devices.

Table 11 – MSC send broadcast service (MSCSB)

Parameter name	Request input	Indication output
Data	M	M (=)

Parameter description

Data

This parameter shall contain the data which is sent to the device.

5.4.4 MSC data notification (MSCDN)

With the MSCDN service, the DL-user shall be notified that message data has been received. This service requires no parameters.

5.4.5 MSC read service (MSCR)

The MSCR service as specified in Table 12 is a local service and shall be used by a DL-user to read message data received from a device.

Table 12 – MSC read service (MSCR)

Parameter name	Request input	Indication output	Response input	Confirmation output
Data			M	M (=)
Error code			M	M (=)
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.				

Parameter description

Data

This parameter shall contain the received data.

Error code

This parameter shall contain the error code for the read request.

5.5 Time synchronization

5.5.1 DL-DelayMeasurement start service (DMS)

With the DMS service as specified in Table 13 a root device in a Type 22 network starts the propagation delay measurement for PCS.

Table 13 – DL-DelayMeasurement start service (DMS)

Parameter name	Request input	Indication output
Repeat count	M	M (=)

Parameter description

Repeat count

This parameter shall indicate the number of communication cycles used for propagation delay measurement.

NOTE Refer to IEC 61158-4-22 for further information about DelayMeasurement sequence.

5.5.2 DL-DelayMeasurement read service (DMR)

With the DMR service as specified in Table 14 a root device in a Type 22 network shall read the propagation delay measurement results.

Table 14 – DL-DelayMeasurement read service (DMR)

Parameter name	Request input	Indication output	Response input	Confirmation output
Delay			M	M (=)
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.				

Parameter description

Delay

This parameter shall contain the delay measurement result.

NOTE Refer to IEC 61158-4-22 for further information about DelayMeasurement sequence.

5.5.3 DL-PCS configuration service (PCSC)

With the PCSC service as specified in Table 15 a root device in a Type 22 network configures the participating devices according to the delay measurement results.

Table 15 – DL-PCS configuration service (PCSC)

Parameter name	Request input	Indication output
Clock configuration	M	M (=)

Parameter description

Clock configuration

This parameter contains the configuration data for clock adjustment.

5.5.4 DL-Sync master configuration service (SYNC_MC)

DL-users which act as synchronization master (SYNC master) shall use the local SYNC_MC service as specified in Table 16 for configuration.

Table 16 – DL-Sync master configuration service (SYNC_MC)

Parameter name	Request input
Sync ID	M
Start time	M
Cycle time	M

Parameter description

Sync ID

This parameter contains the network wide unique ID for the configured sync interrupt.

Start time

This parameter shall contain the absolute start time for the indication of sync interrupt signals in the SYNC master.

Cycle time

This parameter shall contain the cycle time of sync interrupt indication.

5.5.5 DL-Sync start service (SYNC_START)

DL-users which act as synchronization slaves (SYNC slave) shall request information for configuration and activation purposes using the SYNC start service. With the SYNC_START service as specified in Table 17 a Type 22 device shall request configuration information from the corresponding synchronization master and start the indication of sync interrupt signals to the DL-user.

Table 17 – DL-Sync start service (SYNC_START)

Parameter name	Request input	Indication output	Response input	Confirmation output
Sync ID	M	M (=)	M (=)	M (=)
Start time			M	M (=)
Cycle time			M	M (=)

NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is a local matter. The method by which a response primitive is correlated with its corresponding preceding indication primitive is a local matter. See 1.2.

Parameter description

Sync ID

This parameter contains the network wide unique ID for the requested sync interrupt.

Start time

This parameter shall contain the absolute start time of sync interrupt signal indications in the SYNC master.

Cycle time

This parameter shall contain the cycle time of sync interrupt indication.

5.5.6 DL-Sync stop service (SYNC_STOP)

With the SYNC_STOP service as specified in Table 18 a DL-user shall stop the indication of sync interrupt signals to the DL-user.

Table 18 – DL-Sync stop service (SYNC_STOP)

Parameter name	Request input	Indication output
Sync ID	M	M (=)

Parameter description

Sync ID

This parameter indicates the network wide unique ID for the sync interrupt.

5.6 Media independent interface (MII) management services

5.6.1 Overview

The MII management contains a set of optional services. With these MII services registers within the MII can be manipulated.

5.6.2 DL-MII read service (MIIR)

With the local MIIR service as specified in Table 19 information from the MII can be read by the DL-user.

Table 19 – DL-MII read service (MIIR)

Parameter name	Request input	Confirmation output
Address register	M	
Data		M

Parameter description

Address register

This parameter indicates the address of the PHY register which is accessed by the read operation.

Data

This parameter contains the information of the read PHY register.

5.6.3 DL-MII write service (MIIW)

With the local MIIW service as specified in Table 20 information can be written to the MII by the DL-user.

Table 20 – DL-MII write service (MIIW)

Parameter name	Request input
Address register	M
Data	M

Parameter description

Address register

This parameter indicates the address of the PHY register which is accessed by the write operation.

Data

This parameter contains the information to be written to the PHY register.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELD BUS SPECIFICATIONS –**

Part 4–22: Data-link layer protocol specification – Type 22 elements

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WO-2006/069691-A1	[PI]	CONTROL SYSTEM WITH A PLURALITY OF SPATIALLY DISTRIBUTED STATIONS AND METHOD FOR TRANSMITTING DATA IN SAID CONTROL SYSTEM
DE - 10 2004 063 213 - B4	[PI]	Steuerungssystem mit einer Vielzahl von räumlich verteilten Stationen sowie Verfahren zum Übertragen von Daten in einem solchen Steuerungssystem

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until 2012. At this date, the publication will be

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

The list of all parts of the IEC 61158 series, under the general title *Industrial communication networks – Fieldbus specifications*, can be found on the IEC website.

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 implementers 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.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4–22: Data-link layer protocol specification – Type 22 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 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 part of 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 61588:2009, *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*

IETF RFC 768, *User Datagram Protocol*; available at <<http://www.ietf.org>>

IETF RFC 791, *Internet Protocol*; available at <<http://www.ietf.org>>

IEEE 802.1Q, *IEEE Standard for Local and metropolitan area networks – Virtual Bridged Local Area Networks*; available at <<http://www.ieee.org>>

3 Terms, definitions, symbols, abbreviations and conventions

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	[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 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 Common terms and definitions**

NOTE Many definitions are common to more than one protocol Type; they are not necessarily used by all protocol Types.

3.3.1**DL-segment**

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

3.3.2**extended link**

DL-subnetwork, consisting of the maximal set of links interconnected by DL-relays, sharing a single DL-name (DL-address) space, in which any of the connected DL-entities may communicate, one with another, either directly or with the assistance of one or more of those intervening DL-relay entities

NOTE An extended link may be composed of just a single link.

3.3.3**frame**

denigrated synonym for DLPDU

3.3.4**receiving DLS-user**

DL-service user that acts as a recipient of DL-user-data

NOTE A DL-service user can be concurrently both a sending and receiving DLS-user.

3.3.5**sending DLS-user**

DL-service user that acts as a source of DL-user-data

3.4 Additional Type 22 definitions

3.4.1

acyclic data

data which is transferred from time to time for dedicated purposes

3.4.2

bit

unit of information consisting of a 1 or a 0. This is the smallest data unit that can be transmitted

3.4.3

cell

synonym for a single DL-segment which uses RTFL communication model

3.4.4

communication cycle

fixed time period between which the root device issues empty frames for cyclic communication initiation in which data is transmitted utilizing CDC and MSC

3.4.5

cycle time

duration of a communication cycle

3.4.6

cyclic

events which repeat in a regular and repetitive manner

3.4.7

cyclic communication

periodic exchange of frames

3.4.8

cyclic data

data which is transferred in a regular and repetitive manner for dedicated purposes

3.4.9

cyclic data channel (CDC)

part of one or more frames, which is reserved for cyclic data

3.4.10

data

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

3.4.11

device

physical entity connected to the fieldbus

3.4.12

error

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

3.4.13

gateway

device acting as a linking element between different protocols

3.4.14**inter-cell communication**

communication between a RTFL device and a RTFN device or communication between a RTFL device and another RTFL device in different cells linked by RTFN

3.4.15**interface**

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

3.4.16**intra-cell communication**

communication between a RTFL device and another RTFL device in the same cell

3.4.17**link**

synonym for DL-segment

3.4.18**logical double line**

sequence of root device and all ordinary devices processing the communication frame in forward and backward direction

3.4.19**master clock**

global time base for the PCS mechanism

3.4.20**message**

ordered sequence of octets intended to convey data

3.4.21**message channel (MSC)**

part of one or more frames, which is reserved for acyclic data

3.4.22**network**

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

3.4.23**open network**

any ISO/IEC 8802.3 -based network with no further restrictions

3.4.24**ordinary device (OD)**

slave in the communication system, which utilizes RTFL for cyclic and acyclic data interchange with other ODs in the same logical double line

3.4.25**precise clock synchronization (PCS)**

mechanism to synchronize clocks of RTFL devices and maintain a global time base

3.4.26**process data**

data designated to be transferred cyclically or acyclically for the purpose of processing