

DIN EN 61158-4-16

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Ersatzvermerk
siehe unten

**Industrielle Kommunikationsnetze –
Feldbusse –
Teil 4-16: Protokollspezifikation des Data Link Layer
(Sicherheitsschicht) – Typ 16-Elemente (IEC 61158-4-16:2007);
Englische Fassung EN 61158-4-16:2008, nur auf CD-ROM**

Industrial communication networks –

Fieldbus specifications –

Part 4-16: Data-link layer protocol specification – Type 16 elements
(IEC 61158-4-16:2007);

English version EN 61158-4-16:2008, only on CD-ROM

Réseaux de communication industriels –

Spécifications des bus de terrain –

Partie 4-16: Spécification des protocoles des couches de liaison de données – Eléments
de type 16 (CEI 61158-4-16:2007);

Version anglaise EN 61158-4-16:2008, seulement en CD-ROM

Ersatzvermerk

Mit DIN EN 61158-4-1:2008-09, DIN EN 61158-4-2:2008-09, DIN EN 61158-4-3:2008-09,
DIN EN 61158-4-4:2008-09, DIN EN 61158-4-7:2008-09, DIN EN 61158-4-8:2008-09,
DIN EN 61158-4-11:2008-09, DIN EN 61158-4-12:2008-09, DIN EN 61158-4-13:2008-09,
DIN EN 61158-4-14:2008-09, DIN EN 61158-4-17:2008-09, DIN EN 61158-4-18:2008-09 und
DIN EN 61158-4-19:2008-09 Ersatz für DIN EN 61158-4:2005-05;
teilweiser Ersatz für DIN EN 61491:1999-11
Siehe jedoch Beginn der Gültigkeit

Gesamtumfang 111 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE

Beginn der Gültigkeit

Die von CENELEC am 2008-02-01 angenommene EN 61158-4-16 gilt als DIN-Norm ab 2008-09-01.

Daneben darf DIN EN 61158-4:2005-05 und DIN EN 61491:1999-11 noch bis 2011-02-01 angewendet werden.

Nationales Vorwort

Mit DIN EN 61158-4-1:2008-09, DIN EN 61158-4-2:2008-09, DIN EN 61158-4-3:2008-09, DIN EN 61158-4-4:2008-09, DIN EN 61158-4-7:2008-09, DIN EN 61158-4-8:2008-09, DIN EN 61158-4-11:2008-09, DIN EN 61158-4-12:2008-09, DIN EN 61158-4-13:2008-09, DIN EN 61158-4-14:2008-09, DIN EN 61158-4-17:2008-09, DIN EN 61158-4-18:2008-09 und DIN EN 61158-4-19:2008-09 Ersatz für DIN EN 61158-4:2005-05.

Mit DIN EN 61158-2:2008-09, DIN EN 61158-3-16:2008-09, DIN EN 61158-5-16:2008-09, DIN EN 61158-6-16:2008-09, DIN EN 61800-7-204¹⁾ und DIN EN 61800-7-304¹⁾ Ersatz für DIN EN 61491:1999-11.

Vorausgegangener Norm-Entwurf: E DIN EN 61158-400:2006-11.

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

Die enthaltene IEC-Publikation wurde vom SC 65C „Industrial networks“ erarbeitet.

Das IEC-Komitee hat entschieden, dass der Inhalt dieser Publikation bis zu dem Datum (maintenance result date) unverändert bleiben soll, das auf der IEC-Website unter „<http://webstore.iec.ch>“ zu dieser Publikation angegeben ist. Zu diesem Zeitpunkt wird entsprechend der Entscheidung des Komitees die Publikation

- bestätigt,
- zurückgezogen,
- durch eine Folgeausgabe ersetzt oder
- geändert.

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 Europäische Norm EN 60068 durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

¹⁾ In Vorbereitung.

Einführung

Ein Feldbus ist ein digitaler serieller Datenbus für die Kommunikation zwischen Geräten der industriellen Automatisierungstechnik wie beispielsweise Messeinrichtungen, Stellgliedern, Reglern und speicherprogrammierbaren Steuerungen. Die Normen der Reihe DIN EN 61158 legen eine Anzahl von Feldbus-Protokolltypen fest.

Die vorliegende Norm legt das Protokoll des Data Link Layer für Typ 16-Elemente fest (SERCOS I und II). Dieser war in den unten aufgeführten früheren Ausgaben nicht enthalten.

Änderungen

Gegenüber DIN EN 61158-4:2005-05 wurden folgende Änderungen vorgenommen:

- a) Streichung des Typ 6-Feldbusses und des Platzhalters für einen Data Link Layer des Typ 5-Feldbusses wegen zu geringer Marktbedeutung;
- b) Hinzufügung von weiteren Feldbustypen;
- c) Aufteilung in mehrere Teile, jeweils als 4-1, 4-2, ..., 4-19 benummert.

Gegenüber DIN EN 61491:1999-11 wurden folgende Änderungen durchgeführt:

- a) 8-Mbit/s und 16-Mbit/s-Physical Layer berücksichtigt (sog. SERCOS II), siehe hierzu auch DIN EN 61784-1²⁾;
- b) Kommunikationsbezogene Teile in DIN EN 61158-2:2008-09, DIN EN 61158-3-16:2008-09, DIN EN 61158-4-16:2008-09, DIN EN 61158-5-16:2008-09 und DIN EN 61158-6-16:2008-09 übernommen;
- c) Anwendungsbezogene Teile in DIN EN 61800-7-204¹⁾ und DIN EN 61800-7-304¹⁾ übernommen.

Frühere Ausgaben

DIN V 19245-1: 1988-01
 DIN 19245-1: 1991-04
 DIN 19245-2: 1991-04
 DIN EN 50170-1: 1997-07
 DIN EN 50170-2: 1997-07
 DIN EN 50170-3: 1997-07
 DIN EN 50254: 1999-07
 DIN EN 61491: 1999-11
 DIN EN 50170/A1: 2002-11
 DIN EN 50170/A2: 2000-08
 DIN EN 50170/A3: 2002-11
 DIN EN 61158-4: 2005-05

¹⁾ In Vorbereitung.

²⁾ 2. Ausgabe in Vorbereitung.

– Leerseite –

Industrielle Kommunikationsnetze –
Feldbusse –
Teil 4-16: Protokollspezifikation des Data Link Layer (Sicherheitsschicht) –
Typ 16-Elemente
(IEC 61158-4-16:2007)

Industrial communication networks –
Fieldbus specifications –
Part 4-16: Data-link layer protocol specification –
Type 16 elements
(IEC 61158-4-16:2007)

Réseaux de communication industriels –
Spécifications des bus de terrain –
Partie 4-16: Spécification des protocoles des
couches de liaison de données –
Éléments de type 16
(CEI 61158-4-16:2007)

Diese Europäische Norm wurde von CENELEC am 2008-02-01 angenommen. Die CENELEC-Mitglieder sind gehalten, die CEN/CENELEC-Geschäftsordnung zu erfüllen, in der die Bedingungen festgelegt sind, unter denen dieser Europäischen Norm ohne jede Änderung der Status einer nationalen Norm zu geben ist.

Auf dem letzten Stand befindliche Listen dieser nationalen Normen mit ihren bibliographischen Angaben sind beim Zentralsekretariat oder bei jedem CENELEC-Mitglied auf Anfrage erhältlich.

Diese Europäische Norm besteht in drei offiziellen Fassungen (Deutsch, Englisch, Französisch). Eine Fassung in einer anderen Sprache, die von einem CENELEC-Mitglied in eigener Verantwortung durch Übersetzung in seine Landessprache gemacht und dem Zentralsekretariat mitgeteilt worden ist, hat den gleichen Status wie die offiziellen Fassungen.

CENELEC-Mitglieder sind die nationalen elektrotechnischen Komitees von Belgien, Bulgarien, Dänemark, Deutschland, Estland, Finnland, Frankreich, Griechenland, Irland, Island, Italien, Lettland, Litauen, Luxemburg, Malta, den Niederlanden, Norwegen, Österreich, Polen, Portugal, Rumänien, Schweden, der Schweiz, der Slowakei, Slowenien, Spanien, der Tschechischen Republik, Ungarn, dem Vereinigten Königreich und Zypern.

CENELEC

Europäisches Komitee für Elektrotechnische Normung
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique

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Ref. Nr. EN 61158-4-16:2008 D

Vorwort

Der Text des Schriftstücks 65C/474/FDIS, zukünftige 1. Ausgabe von IEC 61158-4-16, ausgearbeitet von dem SC 65C „Industrial networks“ des IEC/TC 65 „Industrial-process measurement, control and automation“, wurde der IEC-CENELEC Parallelen Abstimmung unterworfen und von CENELEC am 2008-02-01 als EN 61158-4-16 angenommen.

Dieser und die weiteren Teile der Normenreihe EN 61158-4 ersetzen EN 61158-4:2004. Zusammen mit EN 61158-2:2008 und denjenigen Normen der Reihe EN 61158, die Typ 16 betreffen, ersetzt sie auch teilweise EN 61491:1998, die gegenwärtig überarbeitet wird (um als Technischer Bericht herausgegeben zu werden).

Gegenüber EN 61158-4:2004 wurden die folgenden Änderungen durchgeführt:

- Streichung des Typ 6-Feldbusses und des Platzhalters für einen Data Link Layer des Typ 5-Feldbusses wegen zu geringer Marktbedeutung;
- Hinzufügung von weiteren Feldbustypen;
- Aufteilung in mehrere Teile, jeweils als 4-1, 4-2, ..., 4-19 benummert.

Nachstehende Daten wurden festgelegt:

- spätestes Datum, zu dem die EN auf nationaler Ebene durch Veröffentlichung einer identischen nationalen Norm oder durch Anerkennung übernommen werden muss (dop): 2008-11-01
- spätestes Datum, zu dem nationale Normen, die der EN entgegenstehen, zurückgezogen werden müssen (dow): 2011-02-01

ANMERKUNG Die Anwendung einiger der aufgeführten Protokolltypen wird durch die Inhaber der Rechte an geistigem Eigentum hieran eingeschränkt. Die Zusage zur begrenzten Freigabe ihrer Rechte an geistigem Eigentum durch die Inhaber erlaubt in jedem Fall die Anwendung eines bestimmten Data Link Layer-Protokolls zusammen mit einem Physical Layer- und einem Application Layer-Protokoll in Typzusammenstellungen, die in der Normenreihe EN 61784 angegeben sind. Die Anwendung der verschiedenen Protokolltypen in anderen Zusammenstellungen erfordert möglicherweise die Erlaubnis des jeweiligen Inhabers der Rechte an dem entsprechenden geistigen Eigentum.

Der Anhang ZA wurde von CENELEC hinzugefügt.

Anerkennungsnotiz

Der Text der Internationalen Norm IEC 61158-4-16:2007 wurde von CENELEC ohne irgendeine Abänderung als Europäische Norm angenommen.

In der offiziellen Fassung sind unter „Literaturhinweise“ zu den aufgelisteten Normen die nachstehenden Anmerkungen einzutragen:

- IEC 61158-5-16 ANMERKUNG Harmonisiert als EN 61158-5-16:2008 (nicht modifiziert).
IEC 61158-6-16 ANMERKUNG Harmonisiert als EN 61158-6-16:2008 (nicht modifiziert).
IEC 61784-1 ANMERKUNG Harmonisiert als EN 61784-1:2008 (nicht modifiziert).

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INTRODUCTION

This part of IEC 61158 is one of a series produced to facilitate the interconnection of automation system components. It is related to other standards in the set as defined by the “three-layer” fieldbus reference model described in IEC/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.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 4-16: Data-link layer protocol specification – Type 16 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 standard. 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 61158-3-16, *Industrial communication networks – Fieldbus specifications - Part 3-16: Data-link layer service definition – Type 16 elements*

IEC 61800-7-20x (all subparts), *Adjustable speed electrical power drive systems – Part 7-20x: Generic interface and use of profiles for power drive systems – Profile type x specification*¹

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

ISO/IEC 7498-3, *Information technology – Open Systems Interconnection – Part 3: 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 13239, *Information technology – Telecommunications and information exchange between systems – High-level data link control (HDLC) procedures*

ITU X.25, *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*

3 Terms, definitions, symbols, abbreviations and conventions

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

3.1 Reference model terms and definitions

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

3.1.1 DL-address	Annex A[7498-3]
3.1.2 DL-address-mapping	Annex B[7498-1]
3.1.3 called-DL-address	Annex C[7498-3]
3.1.4 calling-DL-address	Annex D[7498-3]
3.1.5 centralized multi-end-point-connection	Annex E[7498-1]
3.1.6 DL-connection	Annex F[7498-1]
3.1.7 DL-connection-end-point	Annex G[7498-1]

¹ At present, these subparts are IEC 61800-7-201, 7-202, 7-203 and 7-204.

3.1.8 DL-connection-end-point-identifier	Annex H[7498-1]
3.1.9 DL-connection-mode transmission	Annex I[7498-1]
3.1.10 DL-connectionless-mode transmission	Annex J[7498-1]
3.1.11 correspondent (N)-entities	Annex K[7498-1]
correspondent DL-entities (N=2)	
correspondent Ph-entities (N=1)	
3.1.12 DL-duplex-transmission	Annex L[7498-1]
3.1.13 (N)-entity	Annex M[7498-1]
DL-entity (N=2)	
Ph-entity (N=1)	
3.1.14 DL-facility	Annex N[7498-1]
3.1.15 flow control	Annex O[7498-1]
3.1.16 (N)-layer	Annex P[7498-1]
DL-layer (N=2)	
Ph-layer (N=1)	
3.1.17 layer-management	Annex Q[7498-1]
3.1.18 DL-local-view	Annex R[7498-3]
3.1.19 DL-name	Annex S[7498-3]
3.1.20 naming-(addressing)-domain	Annex T[7498-3]
3.1.21 peer-entities	Annex U[7498-1]
3.1.22 primitive name	Annex V[7498-3]
3.1.23 DL-protocol	Annex W[7498-1]
3.1.24 DL-protocol-connection-identifier	Annex X[7498-1]
3.1.25 DL-protocol-data-unit	Annex Y[7498-1]
3.1.26 DL-relay	Annex Z[7498-1]
3.1.27 reset	Annex AA[7498-1]
3.1.28 responding-DL-address	Annex BB[7498-3]
3.1.29 routing	Annex CC[7498-1]
3.1.30 segmenting	Annex DD[7498-1]
3.1.31 (N)-service	Annex EE[7498-1]
DL-service (N=2)	
Ph-service (N=1)	
3.1.32 (N)-service-access-point	Annex FF[7498-1]
DL-service-access-point (N=2)	
Ph-service-access-point (N=1)	
3.1.33 DL-service-access-point-address	Annex GG[7498-3]
3.1.34 DL-service-connection-identifier	Annex HH[7498-1]

3.1.35 DL-service-data-unit	Annex II[7498-1]
3.1.36 DL-simplex-transmission	Annex JJ[7498-1]
3.1.37 DL-subsystem	Annex KK[7498-1]
3.1.38 systems-management	Annex LL[7498-1]
3.1.39 DL-user-data	Annex MM[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 Other terms and definitions

3.3.1

acknowledge telegram (AT)

telegram, in which each slave inserts its data

3.3.2

broadcast

transmission to all devices in a network without any acknowledgment by the receivers

3.3.3

communication cycle

fixed time period between two master synchronization telegrams in which real-time telegrams are transmitted in the RT channel and non real-time telegrams are transmitted in the IP channel

3.3.4

control unit

control device (e.g., a PLC as specified in the IEC 61131 standard family)

3.3.5

control word

two adjacent octets inside the master data telegram containing commands for the addressed device

3.3.6

cycle time

duration of a communication cycle

3.3.7

cyclic communication

periodic exchange of telegrams

3.3.8

cyclic data

part of a telegram, which does not change its meaning during cyclic operation of the network

3.3.9

cyclic operation

operation in which devices in the communication network are addressed and queried one after the other at fixed, constant time intervals

3.3.10

data exchange

demand dependent, non cyclic transmission (service channel), whereas transmission of information occurs upon master request

3.3.11

delimiter, telegram delimiter

beginning and ending identifiers of a telegram (eight bits: 01111110_B)

3.3.12

device

a slave in the communication network, (e.g., a power drive system as defined in the IEC 61800 standard family, I/O stations as defined in the IEC 61131 standard family)

3.3.13

device address field

address field (eight bits) containing the address of the device

3.3.14

device status

four adjacent octets inside the acknowledge telegram containing status information for each device

3.3.15

DLE station identifier

network address assigned to a DLE

3.3.16

DLE station slot

unit (granularity of one) of position dependent mapping (for cyclic data field) of which a DLE may occupy one or more, delineated by the range beginning at the DLE station identifier with a length equal to the configured number of occupied slots

3.3.17

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

3.3.18

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.

3.3.19

DL(SAP)-address

either an individual DLSAP-address, designating a single DLSAP of a single DLS-user, or a group DL-address potentially designating multiple DLSAPs, each of a single DLS-user

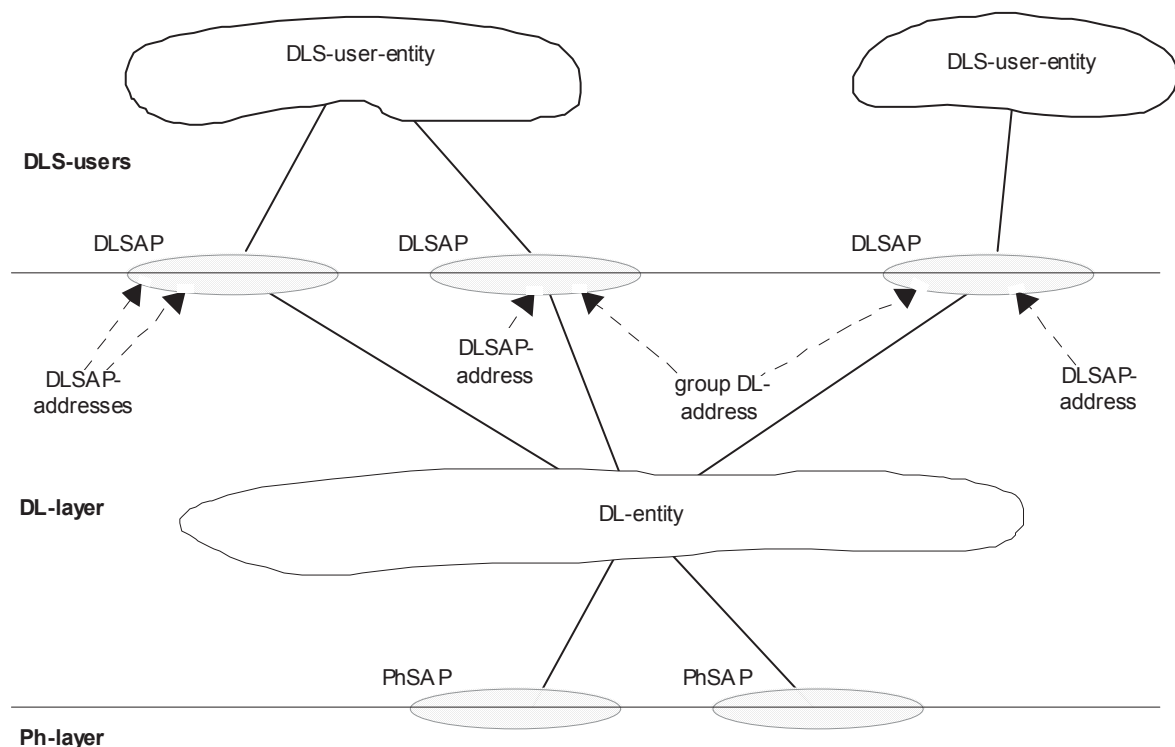
NOTE This terminology is chosen because ISO/IEC 7498-3 does not permit the use of the term DLSAP-address to designate more than a single DLSAP at a single DLS-user.

3.3.20

(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. (See Figure 1.)



- NOTE 1 DLSAPs and PhSAPs are depicted as ovals spanning the boundary between two adjacent layers.
- NOTE 2 DL-addresses are depicted as designating small gaps (points of access) in the DLL portion of a DLSAP.
- NOTE 3 A single DL-entity may have multiple DLSAP-addresses and group DL-addresses associated with a single DLSAP.

Figure 1 – Relationships of DLSAPs, DLSAP-addresses and group DL-addresses

3.3.21 element

part of IDNs – each IDN has 7 elements, whereas each one has a specific meaning (e.g., number, name, data)

3.3.22 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.

3.3.23 frame

denigrated synonym for DLPDU

3.3.24 frame check sequence (FCS)

check character sequence consists of a given number of bits (e.g., 16, 32) which is generated by means of a cyclic redundancy check (CRC) character polynomial in accordance with ITU-T X.25

3.3.25 group DL-address

DL-address that potentially designates more than one DLSAP within the extended link. A single DL-entity may have multiple group DL-addresses associated with a single DLSAP. A single DL-entity also may have a single group DL-address associated with more than one DLSAP

3.3.26

hot plug

possibility to open the communication network and insert or remove slaves while the network is still in real-time operation

3.3.27

identification number (IDN)

designation of operating data under which a data block is preserved with its attribute, name, unit, minimum and maximum input values, and the data

3.3.28

master

node, which assigns the other nodes (i.e., slaves) the right to transmit

3.3.29

master data telegram (MDT)

telegram, in which the master inserts its data

3.3.30

master DLE

DLE that performs the functions of network master

3.3.31

master synchronization telegram (MST)

telegram, or part of a telegram, in which the master inserts a time synchronization signal

3.3.32

node

single DL-entity as it appears on one local link

3.3.33

PDS enable

command to close the feedback loop(s) of a power drive system

3.3.34

PDS on

command that the power stage of a power drive system can be activated

3.3.35

physical layer

first layer of the ISO-OSI reference model

3.3.36

protocol

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

3.3.37

real-time data

part of the telegram that does not change its meaning during cyclic operation of the interface

3.3.38

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.

3.3.39

S-0-nnnn

designation of IDNs

3.3.40

sending DLS-user

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

3.3.41

service channel (SVC)

non real-time transmission of information upon master request during RT channel

3.3.42

status word

two adjacent octets inside the acknowledge telegram containing status information of a device

3.3.43

slave

node, which is assigned the right to transmit by the master

3.3.44

slave DLE

DLE that performs the functions of network slave

3.3.45

station

node

3.3.46

telegram

DLPDU

3.3.47

topology

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

3.4 Abbreviations

3.4.1	AHS	Annex NNservice transport handshake of the device (acknowledge HS)
3.4.2	ASCII	Annex OOAmerican Standard Code for Information Interchange
3.4.3	AT	Annex PPacknowledge telegram
3.4.4	BOF	Annex QQbegin of frame
3.4.5	C1D	Annex RRclass 1 diagnostic
3.4.6	C2D	Annex SSclass 2 diagnostic
3.4.7	C3D	Annex TTclass 3 diagnostic
3.4.8	CA	Annex UUprocedure command acknowledgment
3.4.9	CC	Annex VVcross communication between participants
3.4.10	CP	Annex WWcommunication phase

3.4.11 CPS	Annex XXcommunication phase switching
3.4.12 CRC	Annex YYcyclic redundancy check
3.4.13 DL-	Annex ZZData-link layer (as a prefix)
3.4.14 DLC	Annex AAADL-connection
3.4.15 DLCEP	Annex BBBDL-connection-end-point
3.4.16 DLE	Annex CCCDL-entity (the local active instance of the data-link layer)
3.4.17 DLL	Annex DDDDL-layer
3.4.18 DLPCI	Annex EEEDL-protocol-control-information
3.4.19 DLPDU	Annex FFFDL-protocol-data-unit
3.4.20 DLM	Annex GGGDL-management
3.4.21 DLME	Annex HHHDL-management Entity (the local active instance of DL-management)
3.4.22 DLMS	Annex IIIDL-management Service
3.4.23 DLS	Annex JJJDL-service
3.4.24 DLSAP	Annex KKKDL-service-access-point
3.4.25 DLSDU	Annex LLLDL-service-data-unit
3.4.26 EOF	Annex MMMend of frame
3.4.27 FCS	Annex NNNframe check sequence
3.4.28 FIFO	Annex OOOFirst-in first-out (queuing method)
3.4.29 HS	Annex PPPservice channel handshake (see AHS and MHS)
3.4.30 IDN	Annex QQQIdentification Number
3.4.31 LSB	Annex RRRleast significant bit
3.4.32 Mbit/s	Annex SSSmegabit per second
3.4.33 MDT	Annex TTTmaster data telegram
3.4.34 MDT MST	Annex UUUtype 19 header in MDT
3.4.35 MHS	Annex VVVservice transport handshake of the master
3.4.36 MST	Annex WWWmaster synchronization telegram
3.4.37 OSI	Annex XXXOpen systems interconnection
3.4.38 PDS	Annex YYYpower drive system (see IEC 61800 standard family)
3.4.39 Ph-	Annex ZZZPhysical layer (as a prefix)
3.4.40 PhE	Annex AAAAPh-entity (the local active instance of the physical layer)
3.4.41 PhL	Annex BBBBPh-layer

3.4.42 QoS	Annex CCCCQuality of service
3.4.43 RE	Annex DDDDDResource element
3.4.44 RTC	Annex EEEEReal-time channel
3.4.45 SERCOS	Annex FFFFserial real-time communication system interface
3.4.46 SI	Annex GGGGSub Index
3.4.47 SVC	Annex HHHHService channel

3.5 Symbols

3.5.1 ADR	Annex IIIIdevice address ($1 \leq \text{ADR} \leq 254$) adjusted directly on the device e.g., using a selector switch
3.5.2 INFO	Annex JJJJservice channel information
3.5.3 J_{t_2}	Annex KKKKjitter in t_2
3.5.4 $J_{t_{\text{scyc}}}$	Annex LLLLjitter in t_{Scyc}
3.5.5 MDT0	Annex MMMMmaster data telegram with synchronization data that the slaves evaluates
3.5.6 n_{min}	Annex NNNNshut-off velocity in the PDS after C1D error
3.5.7 SLKN	Annex OOOOslave identification parameter, slave arrangement
3.5.8 SVC	Annex PPPPservice channel
3.5.9 t_1	Annex QQQQAT transmission starting time
3.5.10 $t_{1.m}$	Annex RRRRAT transmission starting time with data record m of slave XX
3.5.11 $t_{1\text{min}}$	Annex SSSSshortest AT transmission starting time
3.5.12 $t_{1\text{min}.m}$	Annex TTTTshortest AT transmission starting time with data record m of slave XX after receiving the MST
3.5.13 t_2	Annex UUUUMDT transmission starting time
3.5.14 t_3	Annex VVVVcommand value valid time
3.5.15 t_5	Annex WWWWminimum feedback processing time
3.5.16 t_{ATAT}	Annex XXXXtransmit to transmit recovery time in a slave with several slaves
3.5.17 t_{ATMT}	Annex YYYYYtransmit/receive transmission time
3.5.18 $t_{\text{ATMT}.M}$	Annex ZZZZtransmit/receive transmission time which slave M needs between transmitting its AT and being prepared for receiving an MDT
3.5.19 t_{ATRP}	Annex AAAAAmaximum transition time in a slave to switch from transmitting an AT to repeater function
3.5.20 t_{MTSG}	Annex BBBBBcommand value processing time

- 3.5.21** t_{MTSY} Annex CCCCCreceive to receive recovery time in a slave
- 3.5.22** $t_{\text{MTSY.K}}$ Annex DDDDDrecovery time of the last slave after the reception of an MDT to switch over for receiving the next MST (the last slave is the one which is served with data record K)
- 3.5.23** t_{Ncyc} Annex EEEEEcontrol unit cycle time
- 3.5.24** t_{RPAT} Annex FFFFFmaximum transition time in a slave to switch from the repeater function to the transmitter function for the AT
- 3.5.25** t_{Scyc} Annex GGGGGcommunication cycle time
- 3.5.26** **XX** Annex HHHHHaddress of a device

3.6 DLPDU IDN concept

All data classes that are handled by Type 16 networks have been assigned identification numbers (IDNs). They include real-time data (commands and feedback values), parameters, and procedures. Several IDNs relate to the application and are defined in their relevant standards (e.g., IEC 61800-7-20x for Power Drive Systems).

Refer to Annex A for additional information.

4 DL-protocol overview

Type 16 profile provides a highly optimized means of interchanging fixed-length real-time data and variable-length segmented messages between a single master device and a set of slave devices, interconnected in a ring topology. The exchange of real-time data is totally synchronous by configuration and is unaffected by the messaging traffic.

The device addresses are set by the user, for example, using a selector. Additional devices may be added whenever required, even during operation, without affecting the address selections, which already exist. The determination of the number, identity and characteristics of each device may be configured or may be detected automatically at start-up.

Slave interfaces shall be used to connect the devices to the network. At the physical layer, a slave represents the connection of one or more devices to the network. Logically, one slave with several devices shall act the same as several slaves with one device each.

There are two classes of Type 16 DLE:

- e) master DLE;
- f) slave DLE.

Only the master DLE is able to initiate the cyclic transmission.

All Type 16 data exchange between the master and the slaves shall take place using defined telegrams. There shall be three sub types of telegrams.

- Master synchronization telegram (MST). MSTs shall be broadcasted by the master at the beginning of a transmission cycle for synchronizing all slaves. They do not transmit any data.
- Master data telegram (MDT). MDTs shall be broadcasted by the master once during each cycle for transmitting its data to all slaves (e.g. command values).
- Device telegrams (AT). ATs shall be sent by each slave once during each cycle for transmitting its data to the master (e.g. feedback values).

Type 16 networks shall not be used for transmitting any other telegrams.

Each device data record in the MDT or AT shall contain a fixed and a configurable part. The fixed part of the data record shall always be present, while the structure of the configurable part of the data record shall be determined for every device by initialization parameters, according to its operation mode and the desired data volume.

5 Basic DLPDU structure

5.1 Overview

5.1.1 General Type 16 telegram structure

Type 16 networks use specific DLPDUs for transporting Type 16 data.

The structure of the DLPDU depends on the telegram type (MST, MDT and AT) and the specific communication phase (CP0-CP6).

The general structure of Type 16 telegrams is shown in Table 1.

Table 1 – General telegram structure

Frame part	Data field	Data type	Value/description
Type 16 telegrams	BOF	OCTET[1]	Telegram delimiter
	ADR	OCTET[1]	Address field
	Data field	OCTET[j × x]	Configurable length
	FCS	OCTET[2]	Frame check sequence
	EOF	OCTET[1]	Telegram delimiter

The administrative segment of the telegram (BOF, ADR, FCS, and (EOF) is required for the transmission of any telegram. The master shall either address telegrams to a specific target or use a broadcast address to transmit messages to all devices concurrently. Slave telegrams (ATs) shall contain the source address.

The User application data shall contain specific information and be handled differently according to the three telegram types and the status of the interface.

5.1.2 BOF telegram delimiter (beginning of frame)

The BOF delimiter shall indicate the start of the telegram. Table 2 shows the content of the field.

Table 2 – BOF field

Bit no,	Value	Description
7	0	Fix value
6-1	1	Fix value
0	0	Fix value

5.1.3 ADR address field

The address field shall be as specified in Table 3.

Table 3 – Device address field

Bit no,	Value	Description
7-0		Device address
	0	Logical device removal
	1 - 254	Device addresses for operation
	255	Reserved

The device address ADR shall be in the range $0 \leq \text{ADR} \leq 255$. It shall be set by the user on the device, for example, using a selector. Each device shall then have its own address ADR. The addresses of all devices that are connected to the same slave shall be in a row.

Any device address in the range $1 \leq \text{ADR} \leq 254$ shall be allocated to not more than one device.

The device address $\text{ADR} = 0$ may be allocated to any number of devices. Devices with such an address shall not generate any telegrams except during network initialization. This makes it possible to remove devices logically from the communication (e.g., for testing purposes).

The device address $\text{ADR} = 255$ shall be reserved.

5.1.4 FCS frame check sequence

A cyclic redundancy check (CRC) shall be used by the transmit and receive algorithms to generate a CRC value for the FCS field. The frame check sequence (FCS) field shall contain a 2 octet (16-bit) cyclic redundancy check (CRC) value. This value shall be computed as a function of the contents of the address and data fields. The FCS shall be generated by the transmitter. The encoding shall be defined as specified in ISO/IEC 13239.

Table 4 – FCS field

Bit no,	Value	Description
15-0		Calculated CRC

5.1.5 EOF telegram delimiter (end of frame)

The EOF delimiter shall indicate the end of a Type 16 telegram. Its content is the same as the BOF telegram delimiter (see Table 2).

5.1.6 Data field

The data field shall be structured according to the three telegram types and the status of the interface (initialization). All transmitted data is allowed to have arbitrary bit sequences of length $j \times 8$ bits.

5.2 MST DLPDU

In the MST, the data field shall only indicate the operation status of the interface and shall be structured as shown in Table 5.

Table 5 – Master synchronization telegram structure

Frame part	Data field	Data type	Value/description
Master data field	INFO	OCTET[1]	Operation status

The INFO field in a MST shall indicate the operation status of the interface. Table 6 shows the content of the field.

Table 6 – MST INFO field

Bit no,	Value	Meaning
7-3	0	Fix value
2-0		Operation status of the interface
	000 _B	CP0 (master attempts to close the ring)
	001 _B	CP1 (address and device identification)
	010 _B	CP2 (parameter mode)
	011 _B	CP3 (cyclic parameter mode)
	100 _B	Reserved
	101 _B	CP4 (cyclic operation)
	010 _B	CP5 (file download)
	111 _B	CP6 (file upload)

5.3 MDT DLPDU

5.3.1 Introduction

5.3.1.1 General MDT telegram structure

Except during initialization, the MDT shall be handled as a broadcast telegram to save time. The data field of the MDT shall be divided into as many data records as there are slaves serviced by the master (see Table 7). The MDT shall contain all the data records which are cyclically sent to all connected slaves by the master.

Table 7 – Data fields of the master data telegram

Frame part	Data field	Data type	Value/description
MDT real-time data field	Real-time data slave #1	OCTET[see Table 8]	
	Real-time data slave #2	OCTET[see Table 8]	
	...		(And so on for slaves #3 to #(K-1).)
	Real-time data slave #K	OCTET[see Table 8]	

Individual data records may have different lengths. During initialization, every data record shall be assigned to its respective device depending upon its address ADR.

They shall remain constant during normal operation, and can be modified only by reinitializing the system, if the configuration requires it.

Each device shall have its own real-time data field as specified in Table 8.

Table 8 – Master real-time data (for each device)

Frame part	Data Field	Data Type	Value/Description
Real-time data slave #k	Control	OCTET[2]	
	Master service INFO	OCTET[see 5.3.1.3]	
	Configurable real-time data	OCTET[see 5.3.4]	

5.3.1.2 Control k – control word for device XX

Table 9 describes the control word as it shall be.

Table 9 – Control word description (DLL)

Bit no,	Value	Control word description
15-11		Reserved for application profile (e.g. IEC 61800-7-20x)
10		Reserved for application layer (IEC 61158-6-16)
9-8		Reserved for application profile (e.g. IEC 61800-7-20x)
7-6		Reserved for application layer (IEC 61158-6-16)
5-3		Data block element
	000	Service channel not active, close service channel or break a transmission in progress
	001	IDN of the operation data. The service channel is closed for the previous IDN and opened for a new IDN
	010	Name of operation data
	011	Attribute of operation data
	100	Unit of the operation data
	101	Minimum input value
	110	Maximum input value
	111	Operation data
2		Bit last transmission
	0	Transmission in progress
	1	Last transmission
1		R/W (read/write)
	0	Read service INFO
	1	Write service INFO
0		MHS (master handshake bit)
	toggle	Service transport handshake of the master

5.3.1.3 Master service INFO k

The length of this field shall be adjusted by the telegram type (S-0-0015) for CP3 and CP4. It shall be 2, 4, 6 or 8 octets long in CP3 and CP4, programmable by telegram type (S-0-0015). It shall always be 2 octets long in CP1 and CP2.

The master service INFO field shall be the container for the non-cyclic data exchange from master to device XX which takes place in steps in special data fields of the telegram.

Figure 2 describes the master service info field as it shall be.

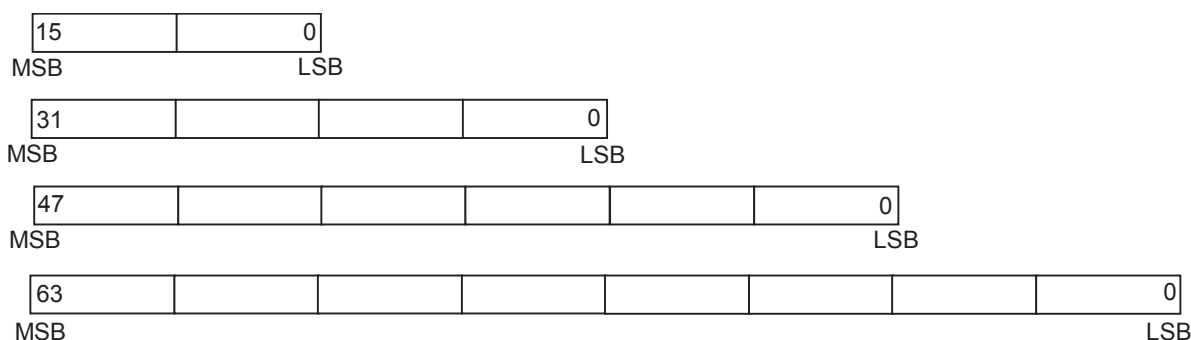


Figure 2 – Master service INFO field k

5.3.2 CP1 and CP2

Device specific identification MDTs (ID request telegrams) shall be used to request the device addresses. Their structure is shown in Table 10.

Table 10 – Structure of the ID request telegram in CP1

Frame part	Data field	Data type	Value/description
Master data field = ID request telegram in CP1	Control	OCTET[2]	0x0001
	Master service INFO	OCTET[2]	

The addressed device shall respond by sending the identification AT (ID acknowledge telegram).

Telegrams in CP2 shall have the same structure as in CP1, but the contents of master service INFO shall now be valid.

5.3.3 CP3

The configurable real-time data field of the MDT shall be used for transmitting individual real-time data to any device. Only element 7 of the data block, configured with a length of two, four or eight octets shall be used. The telegram type parameter S-0-0015 shall determine which operation data is included in the configurable real-time data field of the MDT. The appropriate operation data for standard telegrams shall be defined by this parameter. The structure of the application telegram shall be determined by the configuration list labeled S-0-0024.

The MDT shall be structured as shown in Figure 3. The data field of the MDT shall have as many data records as there are devices which are serviced by the master. Individual data records may vary in length. The assignment of a data record to a device with address XX shall take place during initialization via IDN S-0-0009.

Only the fixed part of the data records shall be used. The configurable part of the data records does not care, but it shall have the number of octets required for cyclical operation. The positions of the fixed part of the data records relevant to the individual devices shall have been transmitted during CP2 with the corresponding communication parameters.

In the control word of the MDT, bit 10 (control unit synchronization bit) shall be valid from CP3 on. This bit shall be set to 0 during phases 0 to 2. In CP3, the control unit shall start the interpolation cycle and keep it steady. Bit 10 of the control word in the MDT shall be inverted with each interpolation cycle.

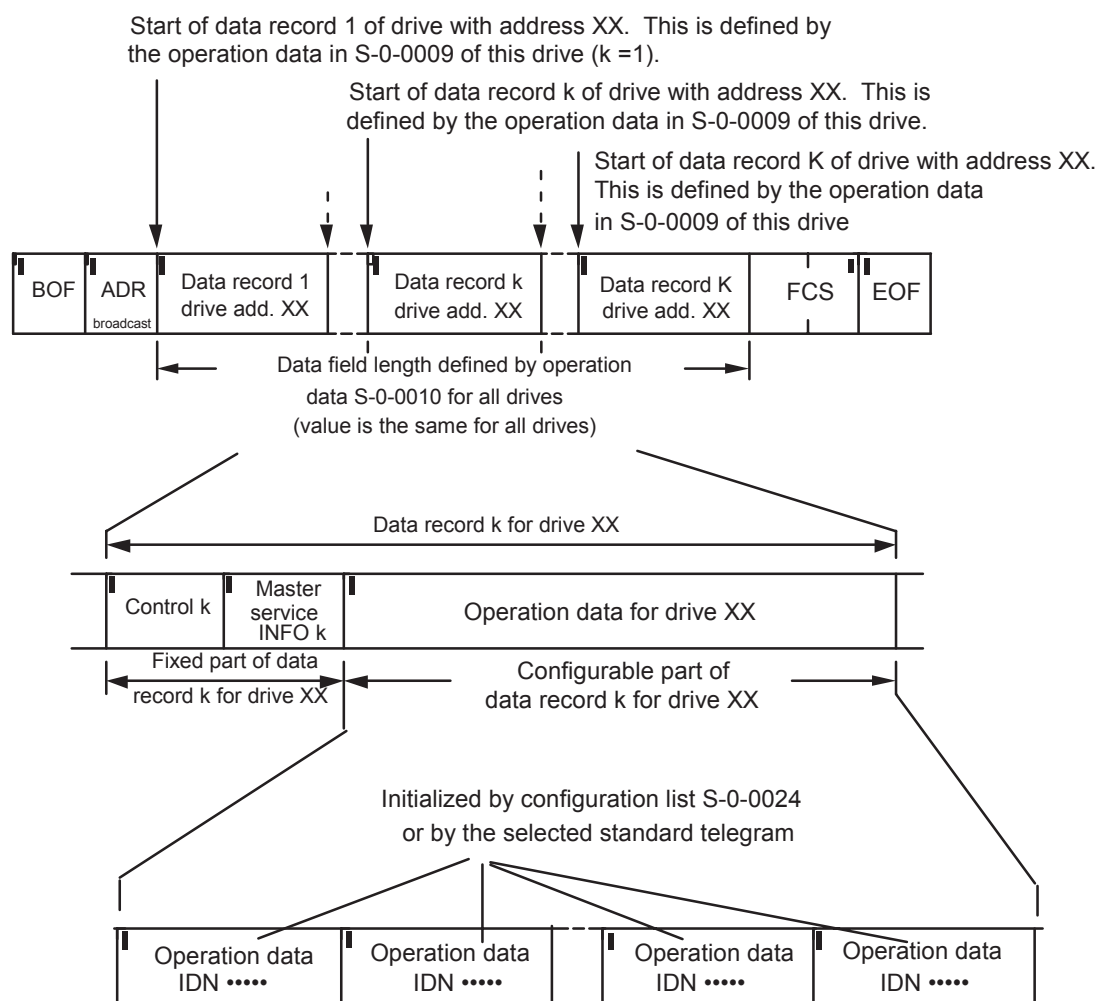


Figure 3 – Structure of the master data telegram

5.3.4 CP4

The MDT shall be structured as shown in Figure 3. The configurable parts of the data records shall be filled with command values which shall have been determined by the parameters transmitted during CP2. The positions of the fixed part of the data records relevant to the individual devices shall have been transmitted during CP2 with the corresponding communication parameters.

5.3.5 CP5

5.3.5.1 CP5 master data description

Table 11 shows the form of the Master Data Telegram for CP5.

Table 11 – Structure of MDT in CP5

Frame part	Data field	Data type	Value/description
Master data field MDT in CP5	Control	OCTET[2]	Unused
	Master service INFO	OCTET[2]	Unused
	Data Record	OCTET[see Table 12]	

The Control Word and the Master Service INFO shall be unused in CP5. The Data Record for the CP5 MDT shall be as specified in Table 12. The File Block size shall be set by the transmission rate as shown in Table 13.

Table 12 – Structure of Data Record in MDT in CP5

Frame part	Data field	Data type	Value/description
Data Record	U/D Control	OCTET[4]	
	File Block Index	OCTET[4]	
	File Block	OCTET[see Table 13]	

Table 13 – File block size in CP5

Transmission rate (Mbit/s)	File block size (octets)	MDT length (octets)	AT length (octets)
2	128	140	12
4	256	268	12
8	512	524	12
16	1024	1036	12

5.3.5.2 U/D control word in CP5

Table 14 defines the bits for the U/D Control Word in the CP5 MDT.

Table 14 – U/D control word in CP5

Bit 31	Value	Meaning
	0	Type 16 interface defined file types
	1	User defined file types
30 - 16		File type identification number
15 - 3		(Reserved)
2		Enable
	0	No file block transfer requested U/D Control word = 0x0001 U/D Status word = 0x0001
	1	File block transfer requested
1		Final Block
	0	Not last block of file transfer
	1	Final block of file transfer
0		U/D Handshake
	toggle	U/D Handshake of master

Before a file transfer may begin, the enable bit, bit 2 in the U/D Control word, shall be set low and the U/D Handshake bit, bit 0 in the U/D Control word shall be set high. If the slave handshake bit matches the master handshake bit, file transfers may begin. File transfers shall be initiated as follows:

- Step 1: Set the File Block Index to 0x0000.
- Step 2: Set the data to be transferred to the MDT File Block Data field.

- Step 3: Set the file type identification number to the File Type Qualifier and File Type Identification Number bits to the file type to be sent.
- Step 4: Set the Enable bit true.
- Step 5: Toggle U/D Handshake bit.

The master shall not change the MDT until the slave has toggled the U/D Handshake bit in the AT to match that of the MDT. If the slave has not toggled the U/D Handshake bit within 10 communication cycles, a fault in the slave shall be assumed.

When the slave toggles the U/D Handshake bit to match that of the master, the slave may also set the U/D Busy bit in the AT indicating that it is processing the data file block being transferred. Only the U/D Handshake bit in the U/D Status word shall be valid while the U/D Busy bit is set. When the slave has completed transfer of the data block and verified the file type and block number, it shall return the File Type Qualifier, File Type Identification Number, set error bits as appropriate and clear the U/D Busy bit in the AT. The master shall not initiate a new data transfer to the same slave until the U/D Handshake bit in that slave AT matches that of the master and the U/D Busy bit is 0.

Subsequent data blocs may be sent by incrementing the file block index of step 1 above and repeating steps 2 through 5. In the event the slave returns an error condition on receipt of any file block, the master may repeat the same file block by leaving the File Block Index unchanged.

The Final Block bit shall be set true when transferring the last block in a series of data transfers. This bit may be used in the slave to complete the file transfer process. This process is not part of this specification.

5.3.5.3 File block index and file block in CP5 (MDT)

A file can be divided into File Blocs that can be downloaded to a slave one File Block at a time. The contents of a file, use and placement of the file by the slave are dependent upon manufacturer implementation. The File Block Index shall be used to indicate which File Block is being transmitted. File blocs shall normally be sent sequentially beginning with File Block 0 and incrementing the block number until the entire file has been sent.

5.3.6 CP6

5.3.6.1 Introduction

Table 15 shows the form of the Master Data Telegram for CP6.

Table 15 – Structure of MDT in CP6

Frame part	Data field	Data type	Value/description
Master data field MDT in CP6	Control	OCTET[2]	Unused
	Master service INFO	OCTET[2]	Unused
	Data Record	OCTET[see Table 16]	

The Control Word and the Master Service INFO shall be unused in CP6. The Data Record for the CP6 MDT shall be as specifies in Table 16.

Table 16 – Structure of data record field in MDT in CP6

Frame part	Data field	Data type	Value/description
Data Record	U/D Control	OCTET[4]	
	File Block Index	OCTET[4]	

5.3.6.2 U/D control word in CP6

Table 17 defines the bits for the U/D Control word in the CP6 MDT.

Table 17 – U/D control word in CP6

Bits	Value	Meaning
31		File type qualifier
	0	Type 16 specific file types
	1	User defined file types
30 - 16		File type identification number
15 - 3		(Reserved)
2		Enable
	0	No file block transfer requested U/D Control word = 0x0001 U/D Status word = 0x0001
	1	File block transfer requested
1		(Reserved)
0		U/D Handshake
	toggle	U/D Handshake of master

Before a file transfer can begin, the enable bit, bit 2 in the U/D Control word, shall be set low and the U/D Handshake bit, bit 0 in the U/D Control word shall be set high. If the slave handshake bit matches the master handshake bit, file transfers shall begin. File transfers shall be initiated following these steps:

- Step 1: Set the File Block Index to 0x0000.
- Step 2: Set the file type number to the File Type Qualifier and File Type Identification Number bits to the file type to be sent.
- Step 3: Set the Enable bit true.
- Step 4: Toggle the U/D Handshake bit.

The slave shall respond by setting the U/D Busy bit true and toggling the U/D Handshake bit in the U/D Status word of the AT.

NOTE It is not necessary for the slave to set the U/D Busy bit true if it can respond with the requested data within the 10 communication cycle period allowed for the U/D Handshake bit to toggle.

After toggling the U/D Handshake bit, the slave shall verify the file type and block number and respond by setting the file type to the File Type bits and the block index number to the File Block Index field respectively, and by setting or clearing the File Transfer Error bit, and place data as appropriate in the Data Block field of the AT. Finally, the slave shall clear the U/D Busy bit in the U/D Status word to tell the master that the data is now valid. Only the U/D Handshake in the U/D Status word is valid when the U/D Busy bit is true. The master shall not initiate a new data transfer until the U/D Handshake bit in the slave AT matches that of the master and the U/D Busy bit is 0.

Subsequent data blocs shall be requested by incrementing the file block index of step 1 above and repeating steps 2 through 4. To transfer the entire file, this process shall be repeated until an error is reported or until the Final Block bit in the AT is set true.

In the event the slave returns an error condition on receipt of any file block, the master may request the same file block by leaving the File Block Index unchanged.

5.3.6.3 File block index in CP6 (MDT)

A file can be divided into File Blocs that can be uploaded from a slave one File Block at a time. The contents of a file, use and placement of the file by the slave are dependent upon manufacturer implementation. The File Block Index shall be used to indicate which File Block is to be uploaded. File blocs shall normally be requested sequentially beginning with File Block 0 and incrementing the block number until the entire file has been received as indicated by the Final Block bit in the AT.

5.4 AT DLPDU

5.4.1 Introduction

5.4.1.1 General AT telegram structure

In the AT, the data field shall have only one data record, which shall be sent from the device to the control unit cyclically, see Table 18. The data records of individual ATs shall be as specified in Table 19.

Table 18 – Data field of the acknowledge telegram

Frame part	Data field	Data type	Value/description
Acknowledge telegram	Real-time data slave #m	OCTET[see Table 19]	

Table 19– AT real-time data (for each device)

Frame part	Data field	Data type	Value/description
Real-time data slave #m	Device m status	OCTET[2]	
	Device m service INFO	OCTET[see 5.4.1.3]	
	Configurable real-time data	OCTET[see 5.4.4]	

5.4.1.2 Status m – status word of device XX

Table 20 describes the status word as it shall be.