

Industrial communication networks — Fieldbus specifications —

Part 4-19: Data-link layer protocol specification — Type 19 elements

ICS 25.040.40; 35.100.20

National foreword

This British Standard is the UK implementation of EN 61158-4-19:2008. It is identical with IEC 61158-4-19:2007. Together with all of the other sections of BS EN 61158-4, it supersedes BS EN 61158-4:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AMT/7, Industrial communications — Process measurement and control, including Fieldbus.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Fieldbus specifications -
Part 4-19: Data-link layer protocol specification -
Type 19 elements
(IEC 61158-4-19:2007)**

Réseaux de communication industriels -
Spécifications des bus de terrain -
Partie 4-19: Spécification des protocoles
des couches de liaison de données -
Éléments de type 19
(CEI 61158-4-19:2007)

Industrielle Kommunikationsnetze -
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Data Link Layer (Sicherheitsschicht) -
Typ 19-Elemente
(IEC 61158-4-19:2007)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

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

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Foreword

The text of document 65C/474/FDIS, future edition 1 of IEC 61158-4-19, prepared by SC 65C, Industrial networks, of IEC TC 65, Industrial-process measurement, control and automation, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61158-4-19 on 2008-02-01.

This and the other parts of the EN 61158-4 series supersede EN 61158-4:2004.

With respect to EN 61158-4:2004 the following changes were made:

- deletion of Type 6 fieldbus, and the placeholder for a Type 5 fieldbus data-link layer, for lack of market relevance;
- addition of new fieldbus types;
- partition into multiple parts numbered 4-1, 4-2, ..., 4-19.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2008-11-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2011-02-01

NOTE Use of some of the associated protocol types is restricted by their intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders of those rights permits a particular data-link layer protocol type to be used with physical layer and application layer protocols in type combinations as specified explicitly in the EN 61784 series. Use of the various protocol types in other combinations may require permission from their respective intellectual-property-right holders.

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Type 19 and possibly other types:

DE 102 37 097	[RI]	Korrektur von Signallaufzeiten in verteilten Kommunikationssystemen
DE 102 00 405 0416.4-42	[RI]	Verfahren zur Synchronisation in einem redundanten Kommunikationssystem
DE 102 00 502 4759.8-32	[RI]	Verfahren zur Laufzeitkorrektur in einer Kommunikationsstruktur
DE 102 00 4056364.0-31	[RI]	Verfahren zum Betreiben eines Netzwerks mit Ringtopologie
DE 103 12 907.3-31	[RI]	Kommunikationssystem mit redundanter Kommunikation

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Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61158-4-19:2007 was approved by CENELEC as a European Standard without any modification.

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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 4-19: Data-link layer protocol specification – Type 19 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 61158-4-16, *Industrial communications networks – Fieldbus specifications – Part 4-16: Data-link layer protocol specification – 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 8802-3, *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*

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:

3.2 Additional Type 19 terms and definitions

3.2.1

broadcast

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

3.2.2

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

3.2.3

control unit

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

3.2.4

control word

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

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

3.2.5**cross communication**

direct data transfer between slave devices (without active involvement of master)

3.2.6**cycle time**

duration of a communication cycle

3.2.7**cyclic communication**

periodic exchange of telegrams

3.2.8**cyclic data**

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

3.2.9**cyclic operation**

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

3.2.10**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)

3.2.11**device address field**

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

3.2.12**device control**

four adjacent OCTETs inside the master data telegram containing commands for each device

3.2.13**device status**

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

3.2.14**DLE station identifier**

network address assigned to a DLE

3.2.15**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

3.2.16**element**

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

3.2.17**EtherType**

part of the Type 19 specific telegram header

3.2.18

forwarding

mode by which a device passes on a received telegram to the other port, either changed or unchanged

3.2.19

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

3.2.20

line, line structure

network topology, in which the transmission medium is routed from station to station in the form of a line; the information is transmitted in one direction from the master down to the last slave in the line, and then flows back to the master via all the slaves in the reverse order (CP16/3)

3.2.21

loopback

mode by which a device passes on a received telegram to the same port and to the other port, either changed or unchanged

3.2.22

master

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

3.2.23

master data telegram (MDT)

telegram, in which the master inserts its data

3.2.24

master DLE

DLE that performs the functions of network master

3.2.25

master synchronization telegram (MST)

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

3.2.26

MDT0 telegram

telegram, in which the master transmits its synchronization data, as well as parts or all of its real-time data, to the slaves

3.2.27

participant

node

3.2.28

physical layer

first layer of the ISO-OSI reference model

3.2.29

protocol

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

3.2.30**real-time data**

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

3.2.31**RT channel**

defined time slot within the communication cycle, which passes the CPF16 real-time telegrams

3.2.32**service channel (SVC)**

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

3.2.33**slave**

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

3.2.34**slave DLE**

DLE that performs the functions of network slave

3.2.35**station**

node

3.2.36**status word**

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

3.2.37**S-0-nnnn**

designation of IDNs

3.2.38**telegram**

DLPDU

3.2.39**topology**

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

3.3 Symbols

3.3.1 ADR	device address ($1 \leq \text{ADR} \leq 254$) adjusted directly on the device e.g., using a selector switch
3.3.2 AT MST	header in AT
3.3.3 AT0...3	acknowledge telegrams
3.3.4 INFO	service channel information
3.3.5 $J_{t_{\text{Scyc}}}$	jitter in t_{Scyc}
3.3.6 MDT0	master data telegram with synchronization data that the slaves evaluates
3.3.7 MDT1...3	master data telegrams without synchronization data
3.3.8 P1	port 1
3.3.9 P2	port 2

3.3.10 RxD	received data
3.3.11 SLKN	slave identification parameter, slave arrangement
3.3.12 SVC	service channel
3.3.13 t_1	AT transmission starting time
3.3.14 t_{1min}	shortest AT transmission starting time
3.3.15 t_3	command value valid time
3.3.16 t_4	feedback acquisition capture point
3.3.17 t_5	minimum feedback processing time
3.3.18 t_{ATAT}	transmit to transmit recovery time in a slave with several slaves
3.3.19 t_{cable}	time, by which the transmitted signal is delayed by the cable, for each unit of length (approx., 5 ns/m)
3.3.20 t_{Ncyc}	control unit cycle time
3.3.21 t_{rep}	time, by which the received signal is delayed by a forwarding slave (input-output)
3.3.22 t_{ring}	time, which a master telegram needs, until it has passed through the network and reached the master again
3.3.23 t_{Scyc}	communication cycle time
3.3.24 TxD	transmitted data

3.4 Abbreviations

3.4.1 AHS	service transport handshake of the device (acknowledge HS)
3.4.2 AT	acknowledge telegram
3.4.3 C1D	class 1 diagnostic
3.4.4 CC	cross communication between participants
3.4.5 CP	communication phase
3.4.6 CPS	communication phase switching
3.4.7 CRC	cyclic redundancy check
3.4.8 FCS	DLPDU check sequence
3.4.9 HS	service channel handshake (see AHS and MHS)
3.4.10 IDN	identification number
3.4.11 MDT	master data telegram
3.4.12 MDT MST	header in MDT
3.4.13 MHS	service transport handshake of the master
3.4.14 MS	communication from slave to master
3.4.15 MST	master synchronization telegram
3.4.16 NRC	non real-time channel
3.4.17 NRT	non real-time mode
3.4.18 RT	real-time
3.4.19 RTC	real-time channel
3.4.20 RTD	real-time data in MDT or AT
3.4.21 SERCOS	serial real-time communication system interface
3.4.22 SFD	start DLPDU delimiter
3.4.23 SVC	service channel

3.5 Additional conventions

3.5.1 DLPDU support level

There are two levels of cycle time support for a DLPDU:

- level B – 50 ns jitter synchronization class (master and slave);
- level C – 50 μ s jitter synchronization class (master and slave).

Refer to 8.2.7 for additional information.

3.5.2 DLPDU IDN concept

All data types are assigned identification numbers (IDNs). They include real-time data (commands and feedback values), parameters, and procedures. Most IDNs are similar to those for Type 16 (see IEC 61158-4-16, 2.4). 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, as well as to IEC 61158-4-16, Annex A.1 for detailed IDN specification.

4 DL-protocol overview

This protocol type 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 or a line topology. The ring topology provides for redundant communication paths, and in case of a fault it automatically switches to a set of two lines without disturbing the communication.

This protocol type also provides for direct real-time data transmission between slaves, inside the real-time channel (RTC), within each cycle.

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 slave 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.

This protocol type also provides a non real-time channel (NRC), in which any Standard Ethernet DLPDUs can be exchanged between Type 19 devices and any other connected Ethernet network nodes.

There are two classes of Type 19 DLE:

- a) master DLE;
- b) slave DLE.

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

Type 19 telegrams are Ethernet DLPDUs according to ISO/IEC 8802-3. Type 19 real-time telegrams shall be transmitted in the real-time part of the communication cycle time. They

transport mainly command values and actual values. Type 19 header specifies two sub types of type 19 telegrams:

- Master data telegram (MDT), in which the master transmits real-time data to the slaves;
- Device telegram (AT), in which the slaves transmit real-time data to other devices.

Other Ethernet DLPDUs can be transmitted in the NRC channel.

Type 19 specifies 4 MDTs (MDT0 to MDT3). The MDTs shall be transmitted by the master and received by each slave. The MDTs shall contain all information (e.g., synchronization, command values, digital outputs) which is sent from the master to the slaves through the real-time channel.

MDT0 shall always be transmitted. MDT1 through 3 shall be transmitted only if required depending on the total amount of data to be transmitted to the slaves. The master shall always send the same number of MDTs during each communication cycle.

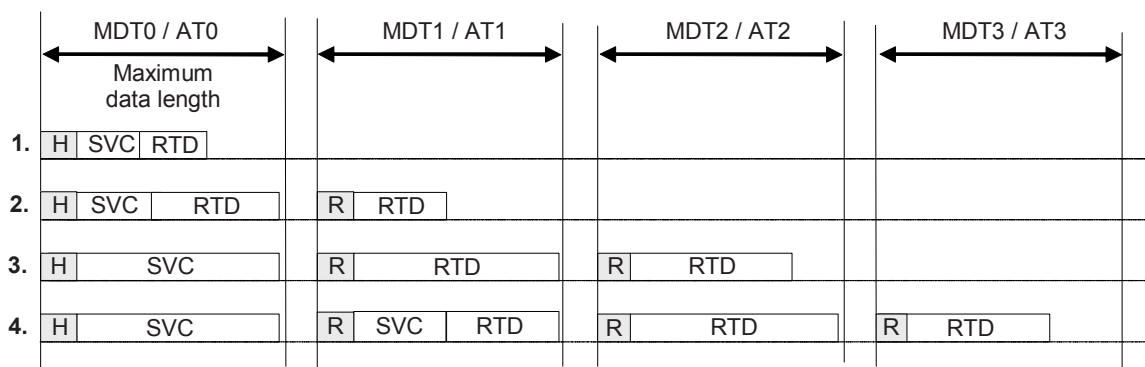
Type 19 specifies 4 ATs (AT0 to AT3). The ATs shall be transmitted by the master with empty data fields. Each slave shall insert its data into its allocated data field within the AT. The ATs shall contain all information (e.g., feedback values, digital inputs) which is sent from the slaves to the master as well as to other slaves through the real-time channel.

AT0 shall always be transmitted. AT1 through 3 shall be transmitted only if required depending on the total amount of data to be transmitted to the master. The master shall always send the same number of ATs during each communication cycle.

The allocations of the service channels (SVC) and the real-time data fields (RTD) in the MDT as well as in the AT shall be configured with parameters. The RTD lengths in the MDTs and the ATs shall depend on the configuration and may be different for each slave depending upon configuration. The number of MDTs and ATs may also be different. This configuration shall meet the following requirements.

- All service channels shall be configured directly after the hot-plug field.
- All real-time data fields shall be configured directly after the last service channel.
- All SVCs of a device shall be transmitted within one MDT and one AT. The telegrams shall be filled up with SVCs as much as possible before using the next MDT and AT.
- All RTDs of a device shall be transmitted within one MDT and one AT. The telegrams shall be filled up with RTDs as much as possible before using the next MDT and AT.

Telegram combinations of MDTs and ATs shall fit to any one of the four possibilities shown in Figure 1, exclusively.



NOTE In this figure, H = hot-plug field, R = reserved.

Figure 1 – Valid MDT and AT telegram combinations

5 DLPDU structure

5.1 Overview

Networks of this protocol type use standard ISO/IEC 8802.3 Ethernet DLPDUs for transporting Type 19 DLPDUs.

5.2 General DLPDU identification

5.2.1 Introduction

DLPDUs shall be identified as specified in Table 1.

Table 1 – Ethernet DLPDU identification

DLPDU field	Data type	Value/description
Dest MAC	OCTET[6]	Destination MAC address
Src MAC	OCTET[6]	Source MAC address
EtherType	WORD	0x88CD (Type 19)

5.2.2 Destination address (Dest MAC)

The master shall transmit DLPDUs to all slaves using the broadcast address 0xFFFF FFFF FFFF as the destination address.

5.2.3 Source address (Src MAC)

The source address shall always be the MAC address of the master.

5.2.4 EtherType

The EtherType for real-time DLPDUs shall contain the value 0x88CD, which is the unique type field number that has been allocated by the IEEE EtherType Field Registration Authority for Type 19 telegrams.

NOTE This field number refers to Type 19 communication.

5.3 General DLPDU structure

5.3.1 Introduction

The data structure in a DLPDU shall consist of the following data entries as specified in Table 2.

Table 2 – Data structure in a DLPDU

Data field	Data type	Value/description
Header	OCTET[6]	Defines the DLPDU type
Payload	OCTET[40-1494]	Data fields are padded

5.3.2 DLPDU header

The DLPDU header shall specify two types of telegrams, as specified in 5.4:

- **Master data telegram (MDT):** MDTs shall transmit data from the master to the slaves;
- **Device telegram (AT):** ATs shall transmit data from the slaves back to the master, as well as to the other slaves.

5.3.3 DLPDU payload

All transmitted data are permitted to have arbitrary bit sequences.

Padding OCTETs shall be added if the Type 19 data is less than 40 OCTETs, in order to reach a total data field length of at least 46 OCTETs.

The DLPDU payload shall be as described in 5.5 and 5.6.

5.4 DLPDU header

5.4.1 Introduction

The DLPDU header shall distinguish the various DLPDUs. It shall be coded in the telegram whether it is in the primary or secondary channel, whether it is an MDT or an AT, and which one (MDT0 to MDT3, respectively AT0 to AT3).

In a line topology, the master shall decide whether the telegrams are marked as primary or secondary telegrams, depending upon configuration.

The DLPDU header structure is shown in Table 3:

Table 3 – DLPDU payload header

Data field	Data type	Value/description
DLPDU type	OCTET[1]	
Reserved	OCTET[1]	
Reserved	OCTET[4]	

5.4.2 Type 19 type

The Type 19 type shall be generated by the master and transmitted in every MDT. Its content shall be as shown in Table 4.

Table 4 – DLPDU type

Bit number.	Value	Description
7		Primary or secondary telegram
	0	Telegram on the primary channel (P-Telegram)
	1	Telegram on the secondary channel (S-Telegram)
6		MDT or AT
	0	MDT
	1	AT
5-2		Reserved
1-0		Telegram number
	00	Telegram number 0
	01	Telegram number 1
	10	Telegram number 2
	11	Telegram number 3

5.5 MDT DLPDU

5.5.1 MDT MST field summary

The MDT is a Type 19 telegram and shall be as specified in Table 5, whereas the Type 19 header is called MDT MST.

Table 5 – MDT MST header

DLPDU part	Data field	Data type	Value/Description
MDT MST header	MDT type	OCTET[1]	
	MDT phase	OCTET[1]	
	MDT CRC	OCTET[4]	

5.5.2 Evaluation of MDT MST in the slaves

The MDT MST shall be generated by the master and evaluated by the slaves. Each slave shall evaluate the MDT MST according to Table 6.

Table 6 – MDT MST fields to be considered by the slave

	MDT type	MDT phase	MDT CRC
MDT0	yes	yes	yes
MDT1	yes	no	no
MDT2	yes	no	no
MDT3	yes	no	no

5.5.3 MDT type

Refer to 5.4.2, whereas bit #6 shall be 0.

5.5.4 MDT phase

The MDT phase shall contain the status of the Type 19 communication during initialization and during normal operation. The phase shall be generated by the master and transmitted in every MDT. The structure is shown in Table 7.

Table 7 – MDT phase

Bit No.	Value	Description
7		Communication phase switching (CPS)
	0	Current CP
	1	New CP
6-4		Reserved
3-0		Communication phase (CP)
	0000	CP0
	0001	CP1
	0010	CP2
	0011	CP3
	0100	CP4
	0101 to 1111	Reserved

5.5.5 MDT CRC

The cyclic redundancy check (CRC) shall be used by the transmit and receive algorithms to generate a CRC value for the MDT CRC field. The MDT CRC field shall contain a 4-OCTET (32-bit) cyclic redundancy check (CRC) value. This value shall be computed as a function of the contents of the destination address (see 5.2.2), source address (see 5.2.3), EtherType (see 5.2.4), Type 19 type (see 5.4.2) and phase (see 5.5.4). The encoding shall be as defined by the Standard Ethernet CRC generating polynomial (see ISO/IEC 8802-3).

The MDT CRC shall be generated by the master and transmitted in every MDT (MDT0 to MDT3). This CRC shall be monitored in MDT0 only, for synchronization purposes.

5.5.6 MDT payload during initialization

5.5.6.1 General

The content of the MDT data field depends on the communication phase and is described in the following subclauses.

5.5.6.2 CP0

The master shall always transmit MDT0 telegrams, and no MDT1, MDT2, nor MDT3 telegrams. MDT0 shall be structured as stated in Table 8.

Table 8 – MDT0 in CP0

DLPDU part	Data Field	Data Type	Value/Description
MDT	Type 19 MDT0	OCTET[1]	
	MDT phase	OCTET[1]	CP0
	MDT CRC	OCTET[4]	
MDT payload	MDT Data Field	OCTET[40]	Shall be padded and not used

5.5.6.3 CP1 and CP2

In CP1 and CP2, the master shall always transmit MDT0 and MDT1 telegrams, but no MDT2, nor MDT3 telegrams.

The MDT data field of the MDT0 shall contain the service channel (see 0) and the device control (see 5.5.7.4.2) of device addresses 0 to 127. The MDT data field of the MDT1 shall contain the service channel and the device control of device addresses 128 to 255. See

Table 9 and Table 10.

A slave shall behave as requested if the handshake bit (MHS) is set to 1 in the corresponding SVC control. The SVC INFO and the device control are “don’t care”.

Telegrams in CP2 shall have the same structure as in CP1, but the contents of SVC INFO shall be valid only in CP2.

The content of device control shall be “don’t care”.

Table 9 – MDT0 in CP1 and CP2

DLPDU part	Data Field	Data Type	Value/Description
MDT MST	Type 19 MDT0	OCTET[1]	
	MDT phase	OCTET[1]	CP1 or CP2
	MDT CRC	OCTET[4]	
MDT data field	Device #0 service, service control	OCTET[2]	
	Device #0 SVC INFO	OCTET[4]	
	...		(And so on for devices #1 to #126)
	Device #127 service, service control	OCTET[2]	
	Device #127 SVC INFO	OCTET[4]	
	Device #0 device control	OCTET[4]	
	...		(And so on for devices #1 to #126)
	Device #127 device control	OCTET[4]	

Table 10 – MDT1 in CP1 and CP2

DLPDU part	Data Field	Data Type	Value/Description
MDT MST	Type 19 MDT1	OCTET[1]	
	MDT phase 1 or 2	OCTET[1]	CP1 or CP2
	MDT CRC	OCTET[4]	
MDT data field	Device #128 service, service control	OCTET[2]	
	Device #128 SVC INFO	OCTET[4]	
	...		(And so on for devices #129 to #254)
	Device #255 service, service control	OCTET[2]	
	Device #255 SVC INFO	OCTET[4]	
	Device #128 device control	OCTET[4]	
	...		(And so on for devices #129 to #254)
	Device #255 device control	OCTET[4]	

5.5.6.4 CP3 and CP4

In CP3 and CP4, the master shall transmit MDTs as in normal operation (see 5.5.7).

In CP3 only the service channel and the device control shall be used. The configurable real-time data of the MDT do not matter, but they shall have the number of OCTETs required for CP4 and normal operation. The positions of the service channels and the real-time data fields in the MDT relevant to the individual slaves shall be as transmitted by the master to the slaves during CP2 with the corresponding communication parameters.

Depending on the application profile some bits in the device control may be valid starting at CP3 and up to CP4.

In CP4, the configurable real-time data shall be valid and filled with command values as determined by the parameters that the master transmitted to the slaves during CP2. The

positions of the service channels and the real-time data fields in the MDT relevant to the individual slaves shall be as transmitted by the master to the slaves during CP2 with the corresponding communication parameters. The device control that depends on the application profile shall be valid.

5.5.7 MDT payload in normal operation

5.5.7.1 Introduction

The MDT payload (see Table 11) shall always contain an MDT hot-plug field (see 5.5.7.2), and either one or both of the following fields:

- an MDT service channel field (see 5.5.7.2.4);
- an MDT real-time data field (see 5.5.7.4).

Table 11 – MDT data field

DLPDU part	Data Field	Data Type	Value/Description
MDT data field	MDT hot-plug field	OCTET[8]	See 5.5.7.2
	MDT service channel field	OCTET[See 0]	Optional. See Figure 1
	MDT real-time data field	OCTET[See 5.5.7.4]	Optional. See Figure 1

For each slave, IDN S-0-1013 shall set the offset for its service channel. IDN S-0-1009 shall set the offset for its real-time data field. IDN S-0-1010 shall contain the length of the MDT (see Figure 2). These parameters shall be transmitted by the master to the slaves in CP2 during initialization.

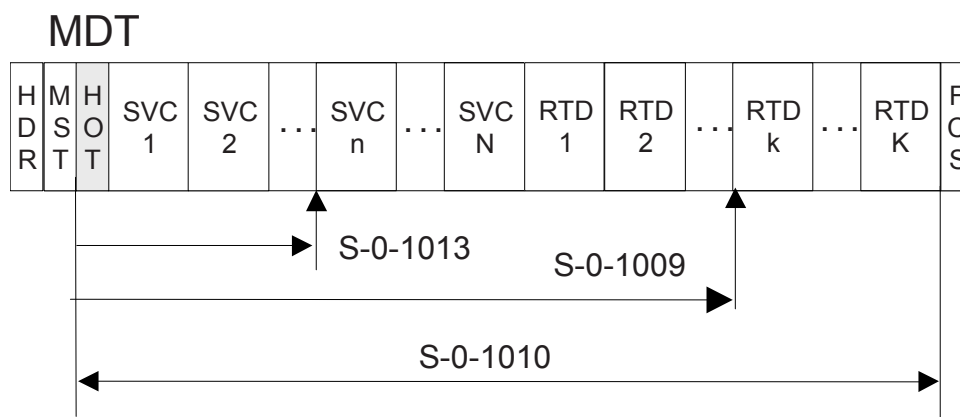


Figure 2 – Offsets within MDT payload

5.5.7.2 MDT hot-plug field

5.5.7.2.1 MDT hot-plug field summary

The structure of the MDT hot-plug field shall be as specified in Table 12 or in Table 13, depending upon hot-plug phase (HP0, HP1, HP2, see 6.3).