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Entwurf

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DIN EN 61784-2:2015-02

**Industrielle Kommunikationsnetze –
Feldbus Spezifikationen und Profile –
Typ 25-Elemente und CPF 20 (ADS-net)
(IEC 65C/831/CD:2015);
Text in Englisch, nur auf CD-ROM**

Industrial communication networks –
Fieldbus specifications and Profiles –
Type 25 elements and CPF 20 (ADS-net)
(IEC 65C/831/CD:2015);
Text in English, only on CD-ROM

Anwendungswarnvermerk

Dieser Norm-Entwurf mit Erscheinungsdatum 2016-06-24 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

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- oder in Papierform an die DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE, Stresemannallee 15, 60596 Frankfurt am Main.

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

Gesamtumfang 283 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

Nationales Vorwort

Die englische Originalfassung des internationalen Dokuments IEC 65C/831/CD:2015 „Industrial communication networks – Fieldbus specifications and Profiles – Type 25 elements and CPF 20 (ADS-net)“ (CD, en: Committee Draft) ist unverändert in diesen Norm-Entwurf übernommen worden.

Das internationale Dokument wurde vom SC 65C „Industrial networks“ der Internationalen Elektrotechnischen Kommission (IEC) erarbeitet und den nationalen Komitees zur Stellungnahme vorgelegt.

Die 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. Dokumente, die bei CENELEC als Europäische Norm angenommen und ratifiziert werden, sind unverändert als Deutsche Normen zu übernehmen.

Da der Abstimmungszeitraum für einen FDIS bzw. Schluss-Entwurf prEN nur 2 Monate beträgt, und dann keine sachlichen Stellungnahmen mehr abgegeben werden können, sondern nur noch eine „JA/NEIN“-Entscheidung möglich ist, wobei eine „NEIN“-Entscheidung fundiert begründet werden muss, wird bereits der CD als DIN-Norm-Entwurf veröffentlicht, um die Stellungnahmen aus der Öffentlichkeit frühzeitig berücksichtigen zu können.

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

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Der Zusammenhang der zitierten Dokumente mit den entsprechenden Deutschen Dokumenten 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.

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 den vorliegenden Norm-entwurf erfüllt.

Da sich die Benutzer des vorliegenden Normentwurfs der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN 61158-100-25 veröffentlicht. Zu deren Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA des vorliegenden Norm-entwurfs hinzugefügt. Für viele der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Normentwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

Es ist vorgesehen, auch bei der entsprechenden zukünftigen Deutschen Norm auf die deutsche Sprachfassung zu verzichten und diese in der englischsprachigen Fassung zu veröffentlichen.

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Das Original-Dokument enthält Bilder in Farbe, die in der Papierversion in einer Graustufen-Darstellung wiedergegeben werden. Elektronische Versionen dieses Dokuments enthalten die Bilder in der originalen Farbdarstellung.

Änderungen

Gegenüber DIN EN 61784-2:2015-02 wurden folgende Änderungen vorgenommen:

- a) Dieser Sammelentwurf enthält neben den einzelnen Entwürfe zu IEC 61158-3-25, IEC 61158-4-25, IEC 61158-5-25, IEC 61158-6-25, welche die neue Kommunikationsprofilfamilie 20 (ADS-net) Typ 25-Elemente beschreibt, ebenfalls eine entsprechende Erweiterung (CPF 20) für die kommende Überarbeitung der DIN EN 61784-2 Ed.3.

Nationaler Anhang NA (informativ)

Die deutschen Übersetzungen haben Empfehlungscharakter und können nur die ungefähre Begrifflichkeit in Deutsch wiedergeben. Unter Experten wird empfohlen, ausschließlich die englischen Fachbegriffe zu verwenden, um die Gefahr von Missverständnissen zu reduzieren.

1 Anwendungsbereich^{N1)}

1.1 Allgemeines

Dieser Teil von IEC 61158 stellt allgemeine Elemente für grundlegende zeitkritische Nachrichtenkommunikation zwischen Geräten in einer automatisierten Umgebung bereit. Der Begriff „zeitkritisch“ wird verwendet, um das Vorhandensein eines Zeitfensters darzustellen, innerhalb dessen der Abschluss einer oder mehrerer festgelegter Aktionen mit einem gewissen festgelegten Grad an Sicherheit gefordert ist. Eine Nichterfüllung des Abschlusses festgelegter Aktionen innerhalb des Zeitfensters birgt die Gefahr des Scheiterns der Anwendung die diese Aktion angefordert hat, mit der daraus entstehenden Gefahr für Betriebsmittel, Anlage und möglicherweise menschliches Leben.

Diese Norm legt in einer abstrakten Weise den extern sichtbaren Dienst fest, welcher durch die Sicherungsschicht des Typ-25-Feldbusses bereitgestellt wird, hinsichtlich:

- a) der Aktionen und Ereignisse von Primitiven des Dienstes;
- b) den Parametern, die den Primitiven der Aktionen und Ereignisse des Dienstes zugehörig sind, und der Form, die sie annehmen; und
- c) der Wechselbeziehung zwischen diesen Aktionen und Ereignissen und ihren gültigen Abfolgen.

Der Zweck dieser Norm ist die Festlegung der Dienste, welche bereitgestellt werden für:

- die Anwendungsschicht des Typ 25-Feldbusses an der Grenze zwischen den Anwendungs- und den Sicherungsschichten des Feldbusreferenzmodells;
- das Systemmanagement an der Grenze zwischen der Sicherungsschicht und dem Systemmanagement des Feldbusreferenzmodells.

1.2 Festlegungen

Das grundlegende Ziel dieser Norm ist die Festlegung der Merkmale von konzeptuellen Diensten der Sicherungsschicht, welche für zeitkritische Kommunikation geeignet sind, und somit die Ergänzung des OSI-Basis-Referenzmodells für die Anleitung zur Entwicklung von Protokollen der Sicherungsschicht für zeitkritische Kommunikationen. Ein sekundäres Ziel ist die Bereitstellung von Migrationspfaden von vorher bestehenden industriellen Kommunikationsprotokollen.

Diese Spezifikation darf als Grundlage für formelle Programmierungsschnittstellen der Sicherungsschicht verwendet werden. Sie ist jedoch keine formelle Programmierungsschnittstelle und jede derartige Schnittstelle muss auch Implementierungsfragen behandeln, welche durch diese Norm nicht abgedeckt sind.

- d) die Größen und Oktettfolgen von verschiedenen Multi-Oktett-Dienstparametern, und
- e) die Beziehung von paarweisen Primitiven für Anfrage und Bestätigung oder Meldung und Antwort.

^{N1)} Nationale Fußnote: Die Nummerierung des IEC-Schriftstücks 65C/831/CD:2015-10 wurde beibehalten.

1.3 Konformität

Diese Norm legt weder einzelne Implementierungen oder Produkte fest, noch schränkt sie die Implementierungen von Instanzen der Sicherungsschicht innerhalb eines industriellen Automatisierungssystems ein.

Es besteht keine Konformität von Betriebsmitteln mit dieser Norm für die Dienstfestlegungen der Sicherungsschicht. Stattdessen wird die Konformität durch Implementierung des entsprechenden Protokolls der Sicherungsschicht erreicht, welches den in dieser Norm festgelegten Diensten der Sicherungsschicht des Typs 25 entspricht.

3.3 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

3.3.1

Blockieren

(en: blocking)

Portzustand, bei welchem der Port nicht an der Kommunikation von Rahmen teilnimmt

3.3.2

Klasse

(en: class)

Bezeichner, welcher den Kommunikationsbereich von RCL-Rahmen und anderen Rahmen bezeichnet

3.3.3

Steuerungskommunikation

(en: control communication)

aperiodische Datenkommunikation für stark zeitkritische Anwendungen

3.3.4

zyklische Kommunikation

periodische Datenkommunikation für Echtzeitkommunikation

3.3.5

DLCEP-Adresse

(en: DLCEP-address)

DL-Adresse, welche entweder

- a) einen gleichrangigen (peer) DL-Verbindungsendpunkt, oder
- b) einen DL-Verbindungsendpunkt eines Mehrfach-Peer-Herausgebers und implizit die entsprechende Gruppe von DL-Verbindungsendpunkten eines Subscribers (Teilnehmers), wobei jeder DL-Verbindungsendpunkt innerhalb eines eindeutigen DLSAP und existiert und einer zugehörigen eindeutigen DLSAP-Adresse zugeordnet ist,

bezeichnet

3.3.6

DL-Segment, Verbindungszweig, lokaler Verbindungszweig

(en: DL-segment, link, local link)

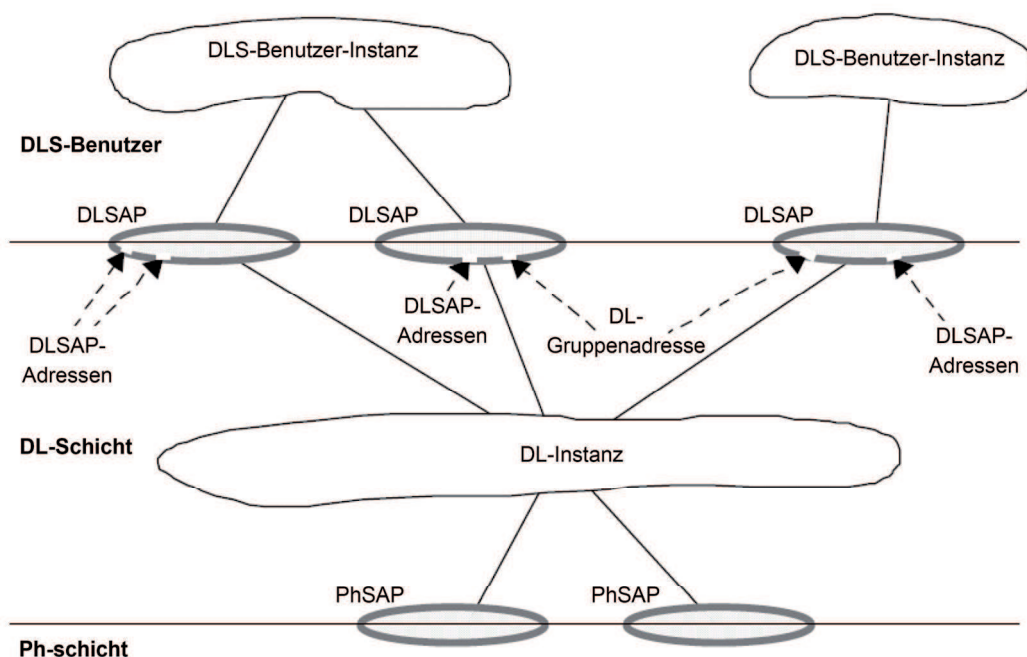
einzelnes DL-Subnetzwerk, in dem alle angeschlossenen DLEs direkt, d. h. ohne zwischengeschaltete DL-Weitergabe, kommunizieren können, solange alle an einem Kommunikationsvorgang teilnehmenden DLEs während der Dauer(n) der Kommunikationsversuche gleichzeitig auf das DL-Subnetzwerk reagieren können

3.3.7

DLSAP

eindeutiger Punkt, an dem eine einzelne DL-Instanz einer einzelnen Instanz auf höherer Schicht DL-Dienste bereitstellt

Anmerkung 1 zum Begriff: Diese von ISO/IEC 7498-1 abgeleitete Definition wird an dieser Stelle wiederholt, um den entscheidenden Unterschied zwischen DLSAP und deren DL-Adressen besser verstehen zu können.



ANMERKUNG 1 DLSAP und PhSAP sind oval dargestellt und erstrecken sich über die Grenze der benachbarten Schichten.

ANMERKUNG 2 DL-Adressen sind als bezeichnende kleine Lücken (Zugangspunkte) im DLL-Teil eines DLSAP dargestellt.

ANMERKUNG 3 Eine einzelne DL-Instanz darf mehrere DLSAP-Adressen und DL-Gruppenadressen haben, welche einem einzelnen DLSAP zugeordnet sind.

Bild 1 – Zusammenhang zwischen DLSAP, DLSAP-Adressen und DLSAP-Gruppenadressen

3.3.8

DL(SAP)-Adresse

entweder eine individuelle DLSAP-Adresse, die einen einzelnen DLSAP eines einzelnen DLS-Benutzers kennzeichnet, oder eine DL-Gruppenadresse, die möglicherweise mehrere DLSAP jeweils eines einzelnen DLS-Benutzers kennzeichnet

Anmerkung 1 zum Begriff: Diese Terminologie wird gewählt, da ISO/IEC 7498-3 die Verwendung der Benennung „DLSAP-Adresse“ zur Bezeichnung von mehr als einem einzelnen DLSAP bei einem einzelnen DLS-Benutzer nicht zulässt.

3.3.9

(individuelle) DLSAP-Adresse

DL-Adresse, die nur einen einzigen DLSAP innerhalb des erweiterten Verbindungszweigs kennzeichnet

Anmerkung 1 zum Begriff: Eine einzelne DL-Instanz kann mehrere DLSAP-Adressen, die einem einzelnen DLSAP zugeordnet sind, besitzen.

3.3.10

erweiterter Verbindungszweig

(en: extended link)

DL-Subnetzwerk, das aus der maximalen Menge von Verbindungszweigen besteht, die über DL-Relais verbunden sind, wobei ein einziger DL-Namensraum (DL-Adressraum) gemeinsam genutzt wird; und in welchem alle angeschlossenen DL-Instanzen miteinander entweder direkt oder über eine oder mehrere der zwischengeschalteten DL-Relais-Instanzen kommunizieren

3.3.11**Rahmen**

(en: frame)

umgangssprachliches Synonym für DLPDU

3.3.12**DL-Gruppenadresse**

DL-Adresse, die möglicherweise mehr als einen DLSAP innerhalb des erweiterten Verbindungszweigs kennzeichnet

Anmerkung 1 zum Begriff: Eine einzelne DL-Entität kann mehrere DL-Gruppenadressen, die einem einzelnen DLSAP zugeordnet sind, besitzen. Eine einzelne DL-Entität kann auch eine einzelne DL-Gruppenadresse, die mehr als einem DLSAP zugeordnet ist, besitzen.

3.3.13**Informationskommunikation**

aperiodische Datenkommunikation für weniger zeitkritische Anwendungen

3.3.14**Knoten**

einzelne DL-Instanz, wie sie an einem lokalen Verbindungszweig existiert

3.3.15**empfangender DLS-Benutzer**

Benutzer eines DL-Dienstes, der als Empfänger von DLS-Benutzerdaten agiert

Anmerkung 1 zum Begriff: Ein Benutzer eines DL-Dienstes kann gleichzeitig sendender und empfangender DLS-Benutzer sein.

3.3.16**Ringsteuerungs-(RCL)-Kommunikation**

(en: ring control (RCL communication))

Nicht-Echtzeit-Kommunikation für Steuerung und Neukonfiguration in Typ 25-DLL-Netzen, die RCL-Rahmen verwenden

3.3.17**sendender DLS-Benutzer**

Benutzer der DL-Dienste, der als Sender von DLS-Benutzerdaten agiert

3.3.18**Station**

Knoten

3.3.19**Stationsadresse**

Kennzeichnungsadresse zur Bezeichnung des Knoten eines Typ-25-Netzwerks

CONTENTS

1		
2		
3	FOREWORD.....	4
4	INTRODUCTION.....	6
5	1 Scope.....	7
6	1.1 General.....	7
7	1.2 Specifications	7
8	1.3 Conformance	7
9	2 Normative references	8
10	3 Terms, definitions, symbols and abbreviations.....	8
11	3.1 Reference model terms and definitions	8
12	3.2 Service convention terms and definitions	9
13	3.3 Terms and definitions	10
14	3.4 Symbols and abbreviations	12
15	3.5 Common conventions	13
16	3.6 Additional Type 25 conventions	14
17	4 DL services and concepts.....	14
18	4.1 Overview	14
19	4.2 Types of DLS	14
20	4.3 Detailed description of the RCL communication service	15
21	4.4 Detailed description of the RT communication service	17
22	5 DL management services	18
23	5.1 General.....	18
24	5.2 Facilities of the DLMS.....	18
25	5.3 Service of the DL-management.....	18
26	5.4 Overview of interactions	19
27	5.5 Detail specification of service and interactions.....	20
28	Bibliography.....	25
29		
30	Figure 1 – Relationships of DLSAPs, DLSAP-addresses and group DL-addresses.....	11
31	Figure 2 – Sequence diagram of RCL communication and RT communication services	15
32	Figure 3 – Reset, Set value, and Get value services	20
33	Figure 4 – Event service	20
34		
35	Table 1 – Primitives and parameters used on the RCL communication service	15
36	Table 2 – Transmit DLSDU primitives and parameters	16
37	Table 3 – Primitives and parameters used on the RT communication service	17
38	Table 4 – Transmit DLSDU primitives and parameters	17
39	Table 5 – Transmit DLSDU primitives and parameters	19
40	Table 6 – DLM_Reset primitives and parameters	20
41	Table 7 – DLM_Set primitives and parameters.....	21
42	Table 8 – DLM_Get primitives and parameters	22
43	Table 9 – DLM_RCL_STOP primitives and parameters	22
44	Table 10 – DLM_RCL_START primitives and parameters	23
45	Table 11 – DLM_RCL_START primitives and parameters	23

46 Table 12 – DLM_Event primitives and parameters 24

47

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –
FIELDBUS SPECIFICATIONS –****Part 3-25: Data-link layer service definition –
Type 25 elements**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61158-3-25 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

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

FDIS	Report on voting
65C/XX/FDIS	65C/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

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

101 The committee has decided that the contents of this publication will remain unchanged until
102 the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data
103 related to the specific publication. At this date, the publication will be

- 104 • reconfirmed,
105 • withdrawn,
106 • replaced by a revised edition, or
107 • amended.

108

109 The National Committees are requested to note that for this publication the stability date
110 is 20XX.

111 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE
112 DELETED AT THE PUBLICATION STAGE.

113

114

115

INTRODUCTION

116 This part of IEC 61158 is one of a series produced to facilitate the interconnection of
117 automation system components. It is related to other standards in the set as defined by the
118 “three-layer” fieldbus reference model described in IEC 61158-1.

119 Throughout the set of fieldbus standards, the term “service” refers to the abstract capability
120 provided by one layer of the OSI Basic Reference Model to the layer immediately above.
121 Thus, the data-link layer service defined in this standard is a conceptual architectural
122 service, independent of administrative and implementation divisions.

123

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 3-25: Data-link layer service definition – Type 25 elements

1 Scope

1.1 General

This part of IEC 61158 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 25 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 25 fieldbus application layer at the boundary between the application and data-link layers of the fieldbus reference model;
- 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

- d) the sizes and octet ordering of various multi-octet service parameters, and
- e) 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 does it 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 fulfills the Type 25 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.

IEC 61158-4-25, *Industrial communication networks – Fieldbus specifications – Part 4-25: Data-link layer protocol specification – Type 25 elements*

IEC 61158-5-25, *Industrial communication networks – Fieldbus specifications – Part 5-25: Application layer service definition – Type 25 elements*

IEC 61158-6-25, *Industrial communication networks – Fieldbus specifications – Part 6-25: Application layer protocol specification – Type 25 elements*

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

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*

3 Terms, definitions, symbols and abbreviations

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	[ISO/IEC 7498-3]
3.1.2	DL-address-mapping	[ISO/IEC 7498-1]
3.1.3	called-DL-address	[ISO/IEC 7498-3]
3.1.4	calling-DL-address	[ISO/IEC 7498-3]
3.1.5	centralized multi-end-point-connection	[ISO/IEC 7498-1]
3.1.6	DL-connection	[ISO/IEC 7498-1]
3.1.7	DL-connection-end-point	[ISO/IEC 7498-1]
3.1.8	DL-connection-end-point-identifier	[ISO/IEC 7498-1]
3.1.9	DL-connection-mode transmission	[ISO/IEC 7498-1]
3.1.10	DL-connectionless-mode transmission	[ISO/IEC 7498-1]
3.1.11	correspondent (N)-entities	[ISO/IEC 7498-1]
	correspondent DL-entities (N=2)	
	correspondent Ph-entities (N=1)	

211	3.1.12	DL-duplex-transmission	[ISO/IEC 7498-1]
212	3.1.13	(N)-entity	[ISO/IEC 7498-1]
213		DL-entity (N=2)	
214		Ph-entity (N=1)	
215	3.1.14	DL-facility	[ISO/IEC 7498-1]
216	3.1.15	flow control	[ISO/IEC 7498-1]
217	3.1.16	(N)-layer	[ISO/IEC 7498-1]
218		DL-layer (N=2)	
219		Ph-layer (N=1)	
220	3.1.17	layer-management	[ISO/IEC 7498-1]
221	3.1.18	DL-local-view	[ISO/IEC 7498-3]
222	3.1.19	DL-name	[ISO/IEC 7498-3]
223	3.1.20	naming-(addressing)-domain	[ISO/IEC 7498-3]
224	3.1.21	peer-entities	[ISO/IEC 7498-1]
225	3.1.22	primitive name	[ISO/IEC 7498-3]
226	3.1.23	DL-protocol	[ISO/IEC 7498-1]
227	3.1.24	DL-protocol-connection-identifier	[ISO/IEC 7498-1]
228	3.1.25	DL-protocol-data-unit	[ISO/IEC 7498-1]
229	3.1.26	DL-relay	[ISO/IEC 7498-1]
230	3.1.27	reset	[ISO/IEC 7498-1]
231	3.1.28	responding-DL-address	[ISO/IEC 7498-3]
232	3.1.29	routing	[ISO/IEC 7498-1]
233	3.1.30	segmenting	[ISO/IEC 7498-1]
234	3.1.31	(N)-service	[ISO/IEC 7498-1]
235		DL-service (N=2)	
236		Ph-service (N=1)	
237	3.1.32	(N)-service-access-point	[ISO/IEC 7498-1]
238		DL-service-access-point (N=2)	
239		Ph-service-access-point (N=1)	
240	3.1.33	DL-service-access-point-address	[ISO/IEC 7498-3]
241	3.1.34	DL-service-connection-identifier	[ISO/IEC 7498-1]
242	3.1.35	DL-service-data-unit	[ISO/IEC 7498-1]
243	3.1.36	DL-simplex-transmission	[ISO/IEC 7498-1]
244	3.1.37	DL-subsystem	[ISO/IEC 7498-1]
245	3.1.38	systems-management	[ISO/IEC 7498-1]
246	3.1.39	DLS-user-data	[ISO/IEC 7498-1]

247

248 3.2 Service convention terms and definitions

249 This standard also makes use of the following terms defined in ISO/IEC 10731 as they apply
250 to the data-link layer:

- 251 **3.2.1 acceptor**
252 **3.2.2 asymmetrical service**
253 **3.2.3 confirm (primitive);**
254 requestor.deliver (primitive)
255 **3.2.4 deliver (primitive)**
256 **3.2.5 DL-confirmed-facility**
257 **3.2.6 DL-facility**
258 **3.2.7 DL-local-view**
259 **3.2.8 DL-mandatory-facility**
260 **3.2.9 DL-non-confirmed-facility**
261 **3.2.10 DL-provider-initiated-facility**
262 **3.2.11 DL-provider-optional-facility**
263 **3.2.12 DL-service-primitive;**
264 primitive
265 **3.2.13 DL-service-provider**
266 **3.2.14 DL-service-user**
267 **3.2.15 DLS-user-optional-facility**
268 **3.2.16 indication (primitive);**
269 acceptor.deliver (primitive)
270 **3.2.17 multi-peer**
271 **3.2.18 request (primitive);**
272 requestor.submit (primitive)
273 **3.2.19 requestor**
274 **3.2.20 response (primitive);**
275 acceptor.submit (primitive)
276 **3.2.21 submit (primitive)**
277 **3.2.22 symmetrical service**

278

279 **3.3 Terms and definitions**

280 **3.3.1 blocking**

281 port state at which the port does not participate in frame communication

282 **3.3.2 class**

283 identifier that designates the communication range of the RCL frames and the other frames

284 **3.3.3 control communication**

285 acyclic data communication for high time-critical applications

286 **3.3.4 cyclic communication**

287 periodic data communication for real-time communication

288 **3.3.5 DLCEP-address**

289 DL-address which designates either

290 a) one peer DL-connection-end-point, or

- b) one multi-peer publisher DL-connection-end-point and implicitly the corresponding set of subscriber DL-connection-end-points where each DL-connection-end-point exists within a distinct DLSAP and is associated with a corresponding distinct DLSAP-address

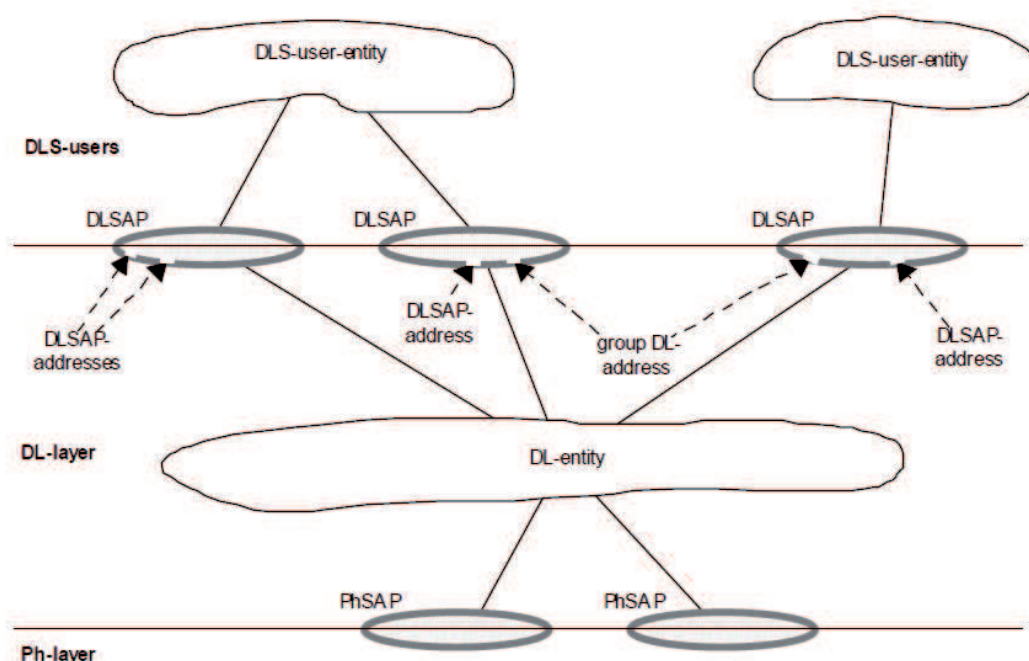
3.3.6 DL-segment, link, local link

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

3.3.7 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.



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

3.3.8 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.

3.3.9 (individual) DLSAP-address

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

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

3.3.10 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

3.3.11 frame

denigrated synonym for DLPDU

3.3.12 group DL-address

DL-address that potentially designates more than one DLSAP within the extended link

NOTE 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.

3.3.13 information communication

acyclic data communication for low time-critical applications

3.3.14 node

single DL-entity as it appears on one local link

3.3.15 receiving DLS-user

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

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

3.3.16 ring control (RCL) communication

non-real-time communication for control and reconfiguration in type 25 DLL network using RCL frames

3.3.17 sending DLS-user

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

3.3.18 station

node

3.3.19 station address

identifier address that designates the node of type 25 network

3.4 Symbols and abbreviations

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

DL-	Data-link layer (as a prefix)
DLC	DL-connection
DLCEP	DL-connection-end-point
DLE	DL-entity (the local active instance of the data-link layer)
DLL	DL-layer
DLM	DL-management
DLME	DL-management Entity (the local active instance of DL-management)
DLMS	DL-management service
DLPCI	DL-protocol-control-information
DLPDU	DL-protocol-data-unit
DLS	DL-service

DLSAP	DL-service-access-point
DLSDU	DL-service-data-unit
EGA	Edge-A node
EGB	Edge-B node
FIFO	First-in first-out (queuing method)
ISL	Isolate node
ITM	Intermediate node
LCA	Loop condition alert (Type 25 frame type)
LCC	Loop condition check (Type 25 frame type)
LCN	Loop condition notify (Type 25 frame type)
LLD	Logical link down
LLU	Logical link up
LNA	Loop notify answer (Type 25 frame type)
NNB	No neighborhood state
OSI	Open systems interconnection
Ph-	Physical layer (as a prefix)
PhE	Ph-entity (the local active instance of the Physical layer)
PhL	Ph-layer
PhS	Ph-service
PLD	Physical link down
PLU	Port A (B) link up state
QoS	Quality-of-service
RCL	Ring control
RCLC	RCL communication control
RHE	Rapid hello (Type 25 frame type)
RT	Real time
RTC	RT communication control
SCR	Station condition report (Type 25 frame type)
TRC	Transmit/Receive control
WLU	Wait link up state

353

354 **3.5 Common conventions**

355 This standard uses the descriptive conventions given in ISO/IEC 10731.

356 The service model, service primitives, and time-sequence diagrams used are entirely
 357 abstract descriptions; they do not represent a specification for implementation.

358 Service primitives, used to represent service user/service provider interactions (see ISO/IEC
 359 10731), convey parameters that indicate information available in the user/provider
 360 interaction.

361 This standard uses a tabular format to describe the component parameters of the DLS
 362 primitives. The parameters that apply to each group of DLS primitives are set out in tables
 363 throughout the remainder of this standard. Each table consists of up to six columns,
 364 containing the name of the service parameter, and a column each for those primitives and
 365 parameter transfer directions used by the DLS:

- 366 – the request primitive's input parameters;
- 367 – the request primitive's output parameters;
- 368 – the indication primitive's output parameters;
- 369 – the response primitive's input parameters;
- 370 – the confirm primitive's output parameters.

371 NOTE The request, indication, response and confirm primitives are also known as requestor.submit,
 372 acceptor.deliver, acceptor.submit, and requestor.deliver primitives, respectively (see ISO/IEC 10731).

373

374 One parameter (or part of it) is listed in each row of each table. Under the appropriate
375 service primitive columns, a code is used to specify the type of usage of the parameter on
376 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.

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

378 a) 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;

379 b) an indication that some note applies to the entry

(n) indicates that the following note n contains additional information pertaining to the parameter and its use.

380

381 In any particular interface, not all parameters need be explicitly stated. Some may be
382 implicitly associated with the DLSAP at which the primitive is issued.

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

386 3.6 Additional Type 25 conventions

387 The following notation, a shortened form of the primitive classes defined in 3.2, is used in
388 the figures.

- 389 **req** request primitive
- 390 **ind** indication primitive
- 391 **cnf** confirm primitive (confirmation)
- 392 **rsp** response primitive

393

394 4 DL services and concepts

395 4.1 Overview

396 This standard specifies the Type 25 data-link services for the ISO/IEC 8802-3 based real-
397 time Ethernet. The Type 25 services extend Ethernet according to the ISO/IEC 8802-3
398 standard with mechanism to control frame flow with IEEE 802.1Q VLAN. The ring topology
399 shall be use in type 25 network. Type 25 network controls the data traffic and without needs
400 time sharing or node synchronization.

401 This standard specifies the data-link services that are the extension part of the ISO/IEC
402 8802-3 based data-link layer.

403 4.2 Types of DLS

404 4.2.1 General

405 The DLS provides the following service primitives for data transmission and reception:

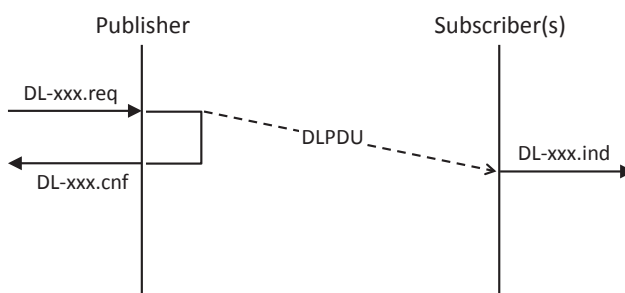
- 406 • RCL communication (for the ring network control and reconfiguration)

- RT communication (for the cyclic, control, and information communication)

The RCL communication controls and reconfigures the Type 25 network and it is non-real-time communication. The RT communication has three types of communication, cyclic, control, and information communication. In cyclic communication, nodes transmit periodically the cyclic communication frames and it guarantees the real-time communication among all nodes on Type 25 network. Control and Information communication are acyclic communication on Type 25 network. Control communication is used in high time-critical acyclic communication. Information communication is used in low time-critical acyclic communication. Control and information communication are non-real-time communication.

4.2.2 Primitive of the RCL communication and RT communication

The sequence of primitives for the RCL communication and RT communication services are shown in Figure 2.



NOTE The method by which a cnf primitive is correlated with its corresponding preceding req primitive is local matter. See 1.2.

Figure 2 – Sequence diagram of RCL communication and RT communication services

4.3 Detailed description of the RCL communication service

4.3.1 Sequence of primitives

These RCL communication service primitives and the parameters are summarized in Table 1, the primitive sequence is shown in Figure 2.

Table 1 – Primitives and parameters used on the RCL communication service

Function	Location	Primitive	Direction	Parameter
Transmit DLSDU	Publisher	DL-RCL.req	To DLE	S_add PortNum Frame_pri RCL_type DLSDU
Confirm DLSDU transmission	Publisher	DL-RCL.cnf	From DLE	Status
Receive DLSDU	Subscriber(s)	DL-RCL.ind	From DLE	S_add PortNum Frame_pri RCL_type DLSDU

4.3.2 Transmit / Receive DLSDU

4.3.2.1 Function

DL-RCL request allows the DLS-user to transfer data for ring control and reconfiguration.

4.3.2.2 Types of primitives and the parameters of the Transmit / Receive DLSDU

Table 2 indicates the parameters of transmit DLSDU service.

Table 2 – Transmit DLSDU primitives and parameters

DL-RCL	Request	Indication	Confirm
Parameter name	Input	Output	Output
S_add	M	M (=)	
Port_Num	M	M	
Frame_pri	M	M (=)	
RCL_type	M	M (=)	
DLSDU	M	M (=)	
Status			M
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is local matter. See 1.2.			

4.3.2.2.1 S_add

The S_add (Source address) parameter specifies the DL-address of the publisher DLE.

4.3.2.2.2 PortNum

The PortNum parameter indicates the port identification for sending and receiving DLSDU. DLE have three types PortNum, A, B, and Both. In the case of PortNum is “Both”, the node transmits the DLSDU to both port A and port B. When node receives DLSDU, the parameter indicating the received port tells whether it is A or B.

4.3.2.2.3 Frame_pri

The Frame_pri parameter specifies the priority with IEEE 802.1Q VLAN on Type 25 network. In RCL communication service, this value is constant indicating the DLSDU for RCL communication.

4.3.2.2.4 RCL_type

The RCL type parameter specifies the frame type for the Type 25 network ring control and reconfiguration. For ring network control, Type 25 network has frames of several types. The frame types are distinguished by the function and communication area.

4.3.2.2.5 DLSDU

This parameter specifies the DLS-user data that is transferred by the DLE.

4.3.2.2.6 Status

This parameter specifies the DLS-user to determine whether the requested service was provided successfully, or failed due to a particular reason. The possible value conveyed in this parameter is as follows:

- a) “success”;
- b) “failure” .

4.4 Detailed description of the RT communication service

4.4.1 Sequence of primitives

The RT communication service primitives and the parameters are summarized in Table 3, the primitive sequence is shown in Figure 2.

Table 3 – Primitives and parameters used on the RT communication service

Function	Location	Primitive	Direction	Parameter
Transmit DLSDU	Publisher	DL-RTC.req	To DLE	D_add S_add Frame_pri DLSDU
Confirm DLSDU transmission	Publisher	DL-RTC.cnf	From DLE	Status
Receive DLSDU	Subscriber(s)	DL-RTC.ind	From DLE	D_add S_add Frame_pri DLSDU

NOTE In this table, time increases from top to bottom.

4.4.2 Transmit / Receive DLSDU

4.4.2.1 Function

DL-RT request allows the DLS-user to transfer data based on ISO/IEC 8802-3. In RT communication, there are three communication types: cyclic, control, and information communication. Type 25 network distinguishes each type of communication by DLSDU parameters.

4.4.2.2 Types of primitives and the parameters of the Transmit / Receive DLSDU

Table 4 indicates the parameters of DLSDU transmission service.

Table 4 – Transmit DLSDU primitives and parameters

DL-RT	Request	Indication	Confirm
Parameter name	Input	Output	Output
D_add	M	M (=)	
S_add	M	M (=)	
Frame_pri	M	M (=)	
DLSDU	M	M (=)	
Status			M
NOTE The method by which a confirm primitive is correlated with its corresponding preceding request primitive is local matter. See 1.2.			

4.4.2.2.1 D_add

The D_add (Destination address) parameter specifies the DL-address of the subscriber DLE. It may be individual or multicast (including broadcast) address. Cyclic communication uses the dedicated multicast address indicating the cyclic communication.

4.4.2.2.2 S_add

The S_add (Source address) parameter specifies the DL-address of the publisher DLE.

4.4.2.2.3 Frame_pri

The Frame_pri parameter specifies the priority with IEEE 802.1Q VLAN on Type 25 network. This value differs among communication types, which are cyclic, control and information communication.

4.4.2.2.4 DLSDU

This parameter specifies the DLS-user data that is transferred by the DLE.

4.4.2.2.5 Status

See 4.3.2.2.6.

5 DL management services**5.1 General**

This clause defines the interface between a DLE and a DL-management user (DLMS-user).

5.2 Facilities of the DLMS

DL-management organizes the initialization, configuration, event and error handling between the DLMS-user and the logical functions in the DLE. The following functions are provided to the DLMS-user:

- a) Reset of the local DLE;
- b) Request for and modification of the actual operating parameters and of the counters of the local DLE;
- c) Notification of unexpected events, errors, and status changes, both local and remote;
- d) Request for identification and for the DLSAP configuration of the local DLE.

5.3 Service of the DL-management**5.3.1 Overview**

DL-management provides the following services to DLMS-user:

- a) Reset;
- b) Set value;
- c) Get value;
- d) RCL stop;
- e) RCL start;
- f) Node status;
- g) Event.

Each service is defined as following subclauses.

NOTE DLMS-user may use this service only when the DLE adopts configurable time slot.

5.3.2 Reset

The DLMS-user utilizes this service to make DL-management to reset the DLE. A reset is equivalent to power on. The DLMS-user receives a confirmation thereof.

5.3.3 Set value

The DLMS-user utilizes this service to assign new values to the variables of the DLE. The DLMS-user receives confirmation that the specified variables have been set to the new values.

5.3.4 Get value

This service allows the DLMS-user to read variables of the DLE. The response of the DL management returns the actual value of the specified variables.

5.3.5 RCL stop

This service is an indicator to stop the designated type RCL frames to DLMS-user.

5.3.6 RCL start

This service is an indicator to start the designated type RCL frames to DLMS-user.

5.3.7 Node status

This service indicates the status of the node and ports to DLMS-user.

5.3.8 Event

DL-management utilizes this service to inform the DLMS-user about certain events or error in the DLL.

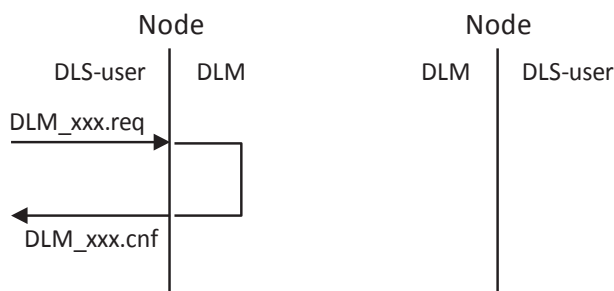
5.4 Overview of interactions

The DL-management services and their primitives are summarized in Table 5.

Table 5 – Transmit DLSDU primitives and parameters

Service	Primitive	Parameter
Reset	DLM_Reset.req	(<none>)
	DLM_Reset.cnf	(out DLM_status)
Set value	DLM_Set.req	(in Variable-name, Desired-value)
	DLM_Set.cnf	(out DLM_status)
Get value	DLM_Get.req	(in Variable-name)
	DLM_Get.cnf	(out DLM_status, Current-value)
RCL stop	DLM_RCL_STOP.ind	(out RCL_Indtype)
RCL start	DLM_RCL_START.ind	(out RCL_Indtype, RCL_IndDA, RCL_IndPri, RCL_IndPort)
Node status	DLM_Node_ST.ind	(out Node_ST, PortA_ST, PortB_ST)
Event	DLM_Event.ind	(out DLM_event identifier, Additional_info)

The temporal relationships of the DL-management primitives are shown in Figure 3 and Figure 4.



NOTE The method by which a cnf primitive is correlated with its corresponding preceding req primitive is local matter. See 1.2.

Figure 3 – Reset, Set value, and Get value services

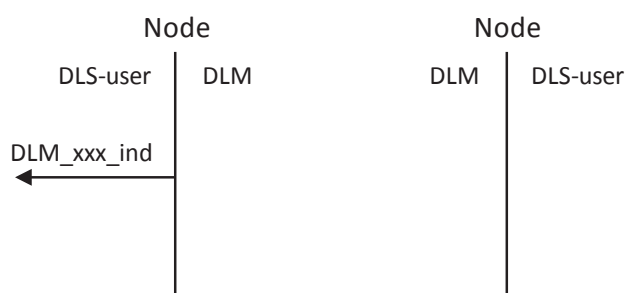


Figure 4 – Event service

5.5 Detail specification of service and interactions

5.5.1 Reset

5.5.1.1 Function

The DML_Reset request primitive causes DLMS to reset the DLE. The DLE is assumed in the “Offline” status, and the reset is carried out in the same manner as in the “power on” procedure; all the DLE variables are cleared. The DLMS user receives the DLM_Reset confirmation primitive along with the status of the result whether it was a success or a failure.

5.5.1.2 Type of primitives and parameters of the Reset

5.5.1.2.1 General

Table 6 indicates the primitives and parameters of the Reset service. This is a local service.

Table 6 – DLM_Reset primitives and parameters

DLM_Reset	Request	Confirm
Parameter name	Input	Output
DLM_Status		M

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

5.5.1.2.2 DLM_status

This parameter allows the DLMS-user to determine whether the requested DLMS was provided successfully, or failed for the reason specified. The value conveyed in this parameter is as follows:

- “OK – successfully completed”;
- “Failure – terminated before completion”.

5.5.2 Set value**5.5.2.1 Function**

This service is used to assign new values to the variables of the DLE. The DLMS-user receives confirmation that the specified variables have been set to the new values.

5.5.2.2 Type of primitives and parameters of the Set value**5.5.2.2.1 General**

Table 7 indicates the primitives and parameters of the Set value service. This is a local service.

Table 7 – DLM_Set primitives and parameters

DLM_Set	Request	Confirm
Parameter name	Input	Output
Variable-name	M	
Desired-value	M	
DLM_status		M

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

5.5.2.2.2 Variable-name

This parameter specifies the variable within the DLE whose value is set. The selectable variables and their permitted values or value ranges are defined in the corresponding part of IEC 61158-4-25.

5.5.2.2.3 Desired-value

This parameter specifies the desired value for the selected variable.

5.5.2.2.4 DLM_status

This parameter allows the DLMS-user to determine whether the requested DLMS was provided successfully, or failed for the reason specified. The value conveyed in this parameter is as follows:

- a) "OK – success – the variable could be updated";
- b) "Failure – the variable does not exist or could not assume the new value";
- c) "Failure – invalid parameters in the request".

5.5.3 Get value**5.5.3.1 Function**

This service can be used to read the value of a DLE variable. The response of the DLMS returns the actual value of the specified variable.

5.5.3.2 Type of primitives and parameters of the Set value**5.5.3.2.1 General**

Table 8 indicates the primitives and parameters of the Get value service. This is a local service.

Table 8 – DLM_Get primitives and parameters

DLM_Get	Request	Confirm
Parameter name	Input	Output
Variable-name	M	
Current-value		M
DLM_status		M

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

5.5.3.2.2 Variable-name

This parameter specifies the variable within the DLE whose value is set. The selectable variables and their permitted values or value ranges are defined in the corresponding part of IEC 61158-4-25.

5.5.3.2.3 Current-value

This parameter is present when the status parameter indicates that the requested service was performed successfully. This parameter specifies the current value of the selected variable.

5.5.3.2.4 DLM_status

This parameter allows the DLMS-user to determine whether the requested DLMS was provided successfully, or failed for the reason specified. The value conveyed in this parameter is as follows:

- a) "OK – success – the variable could be read";
- b) "Failure – the variable does not exist or could not be read";
- c) "Failure – invalid parameters in the request".

5.5.4 RCL stop

5.5.4.1 Function

This service informs the DLMS-user to stop the RCL frames transmission.

5.5.4.2 Type of primitives and parameters of the RCL stop

5.5.4.2.1 General

Table 9 indicates the primitives and parameters of the RCL stop service. This is a local service.

Table 9 – DLM_RCL_STOP primitives and parameters

DLM_RCL_STOP	Indication
Parameter name	Output
RCL_Indtype	M

5.5.4.2.2 RCL_Indtype

This parameter specifies the RCL type of the requested RCL frames for the DLMS-user due to the change of the node status.

5.5.5 RCL start**5.5.5.1 Function**

This service is used to inform the DLMS-user about starting the RCL frames.

5.5.5.2 Type of primitives and parameters of the RCL start**5.5.5.2.1 General**

Table 10 indicates the primitives and parameters of the RCL start service. This is a local service.

Table 10 – DLM_RCL_START primitives and parameters

DLM_RCL_START	Indication
Parameter name	Output
RCL_Indtype	M
RCL_IndDA	M
RCL_IndPri	M
RCL_IndPort	M

5.5.5.2.2 RCL_Indtype

This parameter specifies the RCL type of the requested RCL frames for the DLMS-user due to the change of the node status.

5.5.5.2.3 RCL_IndDA

This parameter specifies the DL-address of the requested RCL frames for the DLMS-user due to the change of the node status.

5.5.5.2.4 RCL_IndPri

This parameter specifies the priority with VLAN of the requested RCL frames for the DLMS-user due to the change of the node status.

5.5.5.2.5 RCL_IndPort

This parameter specifies the transmission port of the requested RCL frames for the DLMS-user due to the change of the node status.

5.5.5.3 Node status**5.5.5.3.1 General**

Table 11 indicates the primitives and parameters of the Node status service. This is a local service.

Table 11 – DLM_RCL_START primitives and parameters

DLM_Node_ST	Indication
Parameter name	Output
Node_ST	M
PortA_ST	M
PortB_ST	M

5.5.5.3.2 Node_ST

This parameter contains the node status (ISL/EGA/EGB/ITM) for the DLMS-user due to the change of the node status.

5.5.5.3.3 PortA_ST

This parameter contains the status of port A on own node for the DLMS-user due to the change of the node status.

5.5.5.3.4 PortB_ST

This parameter contains the status of port B on own node for the DLMS-user due to the change of the node status.

5.5.6 Event**5.5.6.1 Function**

This service is used to inform the DLMS-user about certain internal events or errors to the DLS provider.

5.5.6.2 Type of primitives and parameters of the Event**5.5.6.2.1 General**

Table 12 indicates the primitives and parameters of the Event service. This is a local service.

Table 12 – DLM_Event primitives and parameters

DLM_Event	Indication
Parameter name	Output
DLM_event identifier	M
Additional_information	C

5.5.6.2.2 DLM_event identifier

This parameter specifies the primitive or composite event within the DLE whose occurrence is being announced.

5.5.6.2.3 Additional_information

This field contains device profile or vendor specific additional information.

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686

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691 IEC 61158-4-25, *Industrial communication networks – Fieldbus specifications – Part 4-25:*
692 *Data-link layer protocol specification – Type 25 elements*

693 IEC 61158-5-25, *Industrial communication networks – Fieldbus specifications – Part 5-25:*
694 *Application layer service definition – Type 25 elements*

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

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702 *application integration framework – Part 4: Reference description for Ethernet-based control*
703 *systems*; available at <<http://www.iso.org>>

704

CONTENTS

705			
706			
707	FOREWORD.....	5	
708	INTRODUCTION.....	7	
709	1 Scope.....	9	
710	1.1 General.....	9	
711	1.2 Specifications	9	
712	1.3 Procedures	9	
713	1.4 Applicability	10	
714	1.5 Conformance	10	
715	2 Normative references	10	
716	3 Terms, definitions, symbols and abbreviations.....	10	
717	3.1 Reference model terms and definitions	10	
718	3.2 Service convention terms and definitions	12	
719	3.3 Terms and definitions.....	12	
720	3.4 Symbols and abbreviations	15	
721	3.5 Common conventions.....	15	
722	3.6 Additional Type 25 conventions	16	
723	4 Overview of the DL-protocol	17	
724	4.1 General.....	17	
725	4.2 Overview of the medium access control	18	
726	4.3 Service assumed from PhL	21	
727	4.4 DL Layer architecture.....	22	
728	4.5 Local parameters and variables	23	
729	5 General structure and encoding of PhPDUs and DLPDU and related elements of		
730	procedure.....	24	
731	5.1 Overview	24	
732	5.2 Common MAC frame structure, encoding and elements of procedure.....	24	
733	6 DLPDU-specific structure, encoding and elements of procedure	26	
734	6.1 General.....	26	
735	6.2 Structure of the RCL DLPDU.....	26	
736	7 DLE elements of procedure	28	
737	7.1 Overview	28	
738	7.2 RCL communication control (RCLC).....	28	
739	7.3 Real-time communication control (RTC).....	44	
740	7.4 Transmit/Receive control (TRC)	46	
741	7.5 DLL management protocol (DLM).....	52	
742	Bibliography.....	56	
743			
744	Figure 1 – Relationships of DLSAPs, DLSAP-addresses and group DL-addresses	13	
745	Figure 2 – Ring control in Type 25 network	18	
746	Figure 3 – Communication ranges of Type 25 frames	19	
747	Figure 4 – Priority control with VLAN of Type 25 network	20	
748	Figure 5 – The mechanism of transmission delay in a node	20	
749	Figure 6 – The worst delay in Type 25 network	21	
750	Figure 7 – Data-Link layer internal architecture	22	

751	Figure 8 – Type 25 fieldbus DLPDU frame format	24
752	Figure 9 – RCL frame format.....	26
753	Figure 10 – State transition diagram of RHE_SM-A.....	31
754	Figure 11 – State transition diagram of RHE_SM-B.....	33
755	Figure 12 – The state diagram of RCLNode_SM	36
756	Figure 13 – The state diagram of RCLTR_SM.....	42
757	Figure 14 – The state diagram of RTTR_SM	46
758	Figure 15 – The state diagram of TRC_SM	47
759	Figure 16 – The state diagram of DLM_SM	53
760		
761	Table 1 – State transition descriptions	17
762	Table 2 – Descriptions of state machine elements	17
763	Table 3 – Conventions used in state machine	17
764	Table 4 – Characteristics of the node states	18
765	Table 5 – Characteristic of the frame classes.....	19
766	Table 6 – Data-link layer components	22
767	Table 7 – Destination address format.....	25
768	Table 8 – VLAN tag format.....	25
769	Table 9 – Types and classes of RCL frames	26
770	Table 10 – Structure of RCL header.....	27
771	Table 11 – Class field format	27
772	Table 12 – Destination address field format	27
773	Table 13 –Source address field format.....	28
774	Table 14 – CMD field format	28
775	Table 15 – The primitives and parameters for DLS-user interface	28
776	Table 16 – Parameters used with primitives exchanged between RCLC and DLS-user	29
777	Table 17 – The primitives and parameters for TRC interface.....	29
778	Table 18 – Parameters used with primitives exchanged between RCLC and TRC	29
779	Table 19 – The primitives and parameters for DLM interface.....	30
780	Table 20 – Parameters used with primitives exchanged between RCLC and DLM	30
781	Table 21 – Transitions of RHE_SM-A at RCL communication.....	31
782	Table 22 – Transitions of RHE_SM-B at RCL communication.....	34
783	Table 23 – Transitions of RCLNode_SM at RCL communication	36
784	Table 24 – Transitions of RCLTR_SM at RCL communication	42
785	Table 25 – RCLC function table	43
786	Table 26 – The primitives and parameters for DLS-user interface	44
787	Table 27 – Parameters used with primitives exchanged between RTC and DLS-user.....	44
788	Table 28 – The primitives and parameters for TRC interface.....	45
789	Table 29 – Parameters used with primitives exchanged between RTC and TRC	45
790	Table 30 – The primitives and parameters for DLM interface.....	45
791	Table 31 – Parameters used with primitives exchanged between RTC and DLM	45
792	Table 32 – Transitions of RTTR_SM at RT communication	46
793	Table 33 – RTC function table.....	46

794	Table 34 – The primitives and parameters for DLM interface.....	47
795	Table 35 – Parameters used with primitives exchanged between TRC and DLM	47
796	Table 36 – Transitions of TRC_SM	47
797	Table 37 – TRC function table.....	51
798	Table 38 – Primitives exchanged between DLM and DLS-user.....	52
799	Table 39 – Parameters used with primitives exchanged between DLM and DLS-user.....	53
800	Table 40 – Transitions of DLM_SM	54
801	Table 41 – DLM function table	55
802		
803		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL COMMUNICATION NETWORKS -
FIELDBUS SPECIFICATIONS -Part 4-25: Data-link layer protocol specification -
Type 25 elements

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FDIS	Report on voting
65C/XX/FDIS	65C/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

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

857 The committee has decided that the contents of this publication will remain unchanged until
858 the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data
859 related to the specific publication. At this date, the publication will be

- 860 • reconfirmed,
861 • withdrawn,
862 • replaced by a revised edition, or
863 • amended.
864

865 The National Committees are requested to note that for this publication the stability date is
866 20XX.

867 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE
868 DELETED AT THE PUBLICATION STAGE.

869

870

INTRODUCTION

871 This part of IEC 61158 is one of a series produced to facilitate the interconnection of
872 automation system components. It is related to other standards in the set as defined by the
873 “three-layer” fieldbus reference model described in IEC 61158-1.

874 The data-link protocol provides the data-link service by making use of the services available
875 from the physical layer. The primary aim of this standard is to provide a set of rules for
876 communication expressed in terms of the procedures to be carried out by peer data-link
877 entities (DLEs) at the time of communication. These rules for communication are intended to
878 provide a sound basis for development in order to serve a variety of purposes:

- 879 a) as a guide for implementers and designers;
- 880 b) for use in the testing and procurement of equipment;
- 881 c) as part of an agreement for the admittance of systems into the open systems environment;
- 882 d) as a refinement to the understanding of time-critical communications within OSI.

883 This standard is concerned, in particular, with the communication and interworking of sensors,
884 effectors and other automation devices. By using this standard together with other standards
885 positioned within the OSI or fieldbus reference models, otherwise incompatible systems may
886 work together in any combination.

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

893 The International Electrotechnical Commission (IEC) draws attention to the fact that it is
894 claimed that compliance with this document may involve the use of a patent concerning Type
895 25 elements and possibly other types given in this standard as follows:

896 JP4074631 [HI] Transmission line system, frame transmitter therein, and transmission
897 line switching method

898 JP4653800 [HI] Transmission line system, frame transmission apparatus, method and
899 program for switching transmission line in transmission line system

900 JP4944986 [HI] Transmission line system and transmission line construction method

901 CN1964307 [HI] Transfer path system and frame transfer device in same system,
902 transfer path handover method and system

903 CN101515887 [HI] Transmission line system, frame transmitter therein, transmission line
904 switching method and program

905 IEC takes no position concerning the evidence, validity and scope of this patent right.

906 The holder of this patent right has assured the IEC that he/she is willing to negotiate licences
907 either free of charge or under reasonable and non-discriminatory terms and conditions with
908 applicants throughout the world. In this respect, the statement of the holder of this patent
909 right is registered with IEC. Information may be obtained from:

910 [HI] Hitachi, Ltd.
911 Intellectual Property Division
912 20-2, Saiwai-cho 1-chome, Hitachi-shi,
913 Ibaraki-ken, 317-0073 Japan
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919 patents relevant to their standards. Users are encouraged to consult the data bases for the
920 most up to date information concerning patents.

921

INDUSTRIAL COMMUNICATION NETWORKS - FIELDBUS SPECIFICATIONS -

Part 4-25: Data-link layer protocol specification - Type 25 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 datalink service provider;
- b) procedures for giving communications opportunities to all participating DL-entities, sequentially and in a cyclic manner for deterministic and synchronized transfer at cyclic intervals up to one millisecond;
- c) procedures for giving communication opportunities available for time-critical data transmission together with non-time-critical data transmission without prejudice to the time-critical data transmission;
- d) procedures for giving cyclic and acyclic communication opportunities for time-critical data transmission with prioritized access;
- e) procedures for giving communication opportunities based on standard ISO/IEC 8802-3 medium access control, with provisions for nodes to be added or removed during normal operation;
- f) the structure of the fieldbus DLPDUs used for the transfer of data and control information by the protocol of this standard, and their representation as physical interface data units.

1.3 Procedures

The procedures are defined in terms of

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

1.4 Applicability

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

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

1.5 Conformance

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

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61158-3-25, *Industrial communication networks – Fieldbus specifications – Part 3-25: Data-link layer service definition – Type 25 elements*

IEC 61158-5-25, *Industrial communication networks – Fieldbus specifications – Part 5-25: Application layer service definition – Type 25 elements*

IEC 61158-6-25, *Industrial communication networks – Fieldbus specifications – Part 6-25: Application layer protocol specification – Type 25 elements*

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

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*

IEEE 802.1D-2004, *IEEE Standard for Local and metropolitan area networks – Media access control (MAC) Bridges, available at <<http://www.ieee.org>>*

IEEE 802.1Q-2005, *IEEE Standard for Local and metropolitan area networks – Virtual Bridged Local Area Networks, available at <<http://www.ieee.org>>*

3 Terms, definitions, symbols and abbreviations

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:

1011	3.1.1	DL-address	[ISO/IEC 7498-3]
1012	3.1.2	DL-address-mapping	[ISO/IEC 7498-1]
1013	3.1.3	called-DL-address	[ISO/IEC 7498-3]
1014	3.1.4	calling-DL-address	[ISO/IEC 7498-3]
1015	3.1.5	centralized multi-end-point-connection	[ISO/IEC 7498-1]
1016	3.1.6	DL-connection	[ISO/IEC 7498-1]
1017	3.1.7	DL-connection-end-point	[ISO/IEC 7498-1]
1018	3.1.8	DL-connection-end-point-identifier	[ISO/IEC 7498-1]
1019	3.1.9	DL-connection-mode transmission	[ISO/IEC 7498-1]
1020	3.1.10	DL-connectionless-mode transmission	[ISO/IEC 7498-1]
1021	3.1.11	correspondent (N)-entities	[ISO/IEC 7498-1]
1022		correspondent DL-entities (N=2)	
1023		correspondent Ph-entities (N=1)	
1024	3.1.12	DL-duplex-transmission	[ISO/IEC 7498-1]
1025	3.1.13	(N)-entity	[ISO/IEC 7498-1]
1026		DL-entity (N=2)	
1027		Ph-entity (N=1)	
1028	3.1.14	DL-facility	[ISO/IEC 7498-1]
1029	3.1.15	flow control	[ISO/IEC 7498-1]
1030	3.1.16	(N)-layer	[ISO/IEC 7498-1]
1031		DL-layer (N=2)	
1032		Ph-layer (N=1)	
1033	3.1.17	layer-management	[ISO/IEC 7498-1]
1034	3.1.18	DL-local-view	[ISO/IEC 7498-3]
1035	3.1.19	DL-name	[ISO/IEC 7498-3]
1036	3.1.20	naming-(addressing)-domain	[ISO/IEC 7498-3]
1037	3.1.21	peer-entities	[ISO/IEC 7498-1]
1038	3.1.22	primitive name	[ISO/IEC 7498-3]
1039	3.1.23	DL-protocol	[ISO/IEC 7498-1]
1040	3.1.24	DL-protocol-connection-identifier	[ISO/IEC 7498-1]
1041	3.1.25	DL-protocol-data-unit	[ISO/IEC 7498-1]
1042	3.1.26	DL-relay	[ISO/IEC 7498-1]
1043	3.1.27	reset	[ISO/IEC 7498-1]
1044	3.1.28	responding-DL-address	[ISO/IEC 7498-3]
1045	3.1.29	routing	[ISO/IEC 7498-1]
1046	3.1.30	segmenting	[ISO/IEC 7498-1]
1047	3.1.31	(N)-service	[ISO/IEC 7498-1]
1048		DL-service (N=2)	
1049		Ph-service (N=1)	
1050	3.1.32	(N)-service-access-point	[ISO/IEC 7498-1]
1051		DL-service-access-point (N=2)	
1052		Ph-service-access-point (N=1)	

1053	3.1.33	DL-service-access-point-address	[ISO/IEC 7498-3]
1054	3.1.34	DL-service-connection-identifier	[ISO/IEC 7498-1]
1055	3.1.35	DL-service-data-unit	[ISO/IEC 7498-1]
1056	3.1.36	DL-simplex-transmission	[ISO/IEC 7498-1]
1057	3.1.37	DL-subsystem	[ISO/IEC 7498-1]
1058	3.1.38	systems-management	[ISO/IEC 7498-1]
1059	3.1.39	DLS-user-data	[ISO/IEC 7498-1]

1060

1061 **3.2 Service convention terms and definitions**

1062 This standard also makes use of the following terms defined in ISO/IEC 10731 as they apply
1063 to the data-link layer:

1064	3.2.1	acceptor
1065	3.2.2	asymmetrical service
1066	3.2.3	confirm (primitive);
1067		requestor.deliver (primitive)
1068	3.2.4	deliver (primitive)
1069	3.2.5	DL-confirmed-facility
1070	3.2.6	DL-facility
1071	3.2.7	DL-local-view
1072	3.2.8	DL-mandatory-facility
1073	3.2.9	DL-non-confirmed-facility
1074	3.2.10	DL-provider-initiated-facility
1075	3.2.11	DL-provider-optional-facility
1076	3.2.12	DL-service-primitive;
1077		primitive
1078	3.2.13	DL-service-provider
1079	3.2.14	DL-service-user
1080	3.2.15	DLS-user-optional-facility
1081	3.2.16	indication (primitive);
1082		acceptor.deliver (primitive)
1083	3.2.17	multi-peer
1084	3.2.18	request (primitive);
1085		requestor.submit (primitive)
1086	3.2.19	requestor
1087	3.2.20	response (primitive);
1088		acceptor.submit (primitive)
1089	3.2.21	submit (primitive)
1090	3.2.22	symmetrical service

1091

1092 **3.3 Terms and definitions**

1093 **3.3.1 blocking**

1094 a port state which does not participate in frame communication

3.3.2 class

identifiers that designate communication range of the RCL frame and the other frames

3.3.3 control communication

non-real-time acyclic data communication for higher priority applications and node control communication

3.3.4 cyclic communication

periodic data communication for real-time communication

3.3.5 DLCEP-address

DL-address which designates either

a) one peer DL-connection-end-point, or

b) one multi-peer publisher DL-connection-end-point and implicitly the corresponding set of subscriber DL-connection-end-points where each DL-connection-end-point exists within a distinct DLSAP and is associated with a corresponding distinct DLSAP-address.

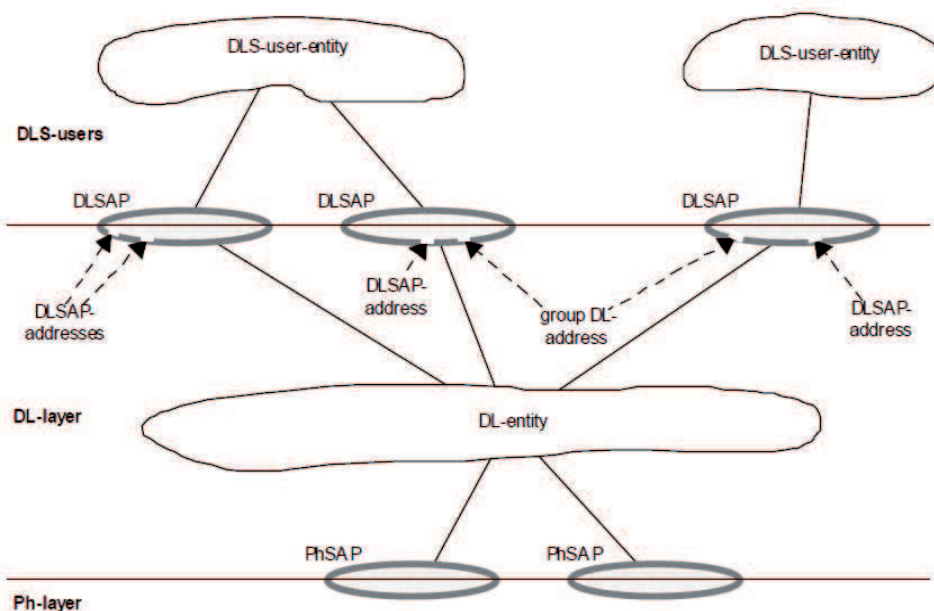
3.3.6 DL-segment, link, local link

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

3.3.7 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.



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

3.3.8 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.

3.3.9 (individual) DLSAP-address

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

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

3.3.10 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

3.3.11 frame

denigrated synonym for DLPDU

3.3.12 group DL-address

DL-address that potentially designates more than one DLSAP within the extended link

NOTE 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.

3.3.13 information communication

non-real-time acyclic data communication for low priority applications

3.3.14 logical link down

link status at which the port is in a blocking state and does not communicate all kinds of frames except RCL frames

3.3.15 logical link up

link status at which the port communicates all kinds of frames

3.3.16 node

single DL-entity as it appears on one local link

3.3.17 physical link down

link status at which the port does not communicate the frames due to link down status defined in ISO/IEC 8802-3

3.3.18 receiving DLS-user

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

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

3.3.19 ring control (RCL) communication

control communication of type 25 DLL ring network using RCL frames and non-real-time

3.3.20 sending DLS-user

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

3.3.21 station

node

1168 **3.3.22 station address**

1169 identifier address that designates the node of type 25 network

1170 **3.4 Symbols and abbreviations**1171 NOTE Many symbols and abbreviations are common to more than one protocol Type; they are not necessarily
1172 used by all protocol Types

DL-	Data-link layer (as a prefix)
DLC	DL-connection
DLCEP	DL-connection-end-point
DLE	DL-entity (the local active instance of the data-link layer)
DLL	DL-layer
DLM	DL-management
DLME	DL-management Entity (the local active instance of DL-management)
DLMS	DL-management service
DLPCI	DL-protocol-control-information
DLPDU	DL-protocol-data-unit
DLS	DL-service
DLSAP	DL-service-access-point
DLSDU	DL-service-data-unit
EGA	Edge-A node
EGB	Edge-B node
FIFO	First-in first-out (queuing method)
ISL	Isolate node
ITM	Intermediate node
LCA	Loop condition alert (Type 25 frame type)
LCC	Loop condition check (Type 25 frame type)
LCN	Loop condition notify (Type 25 frame type)
LLD	Logical link down
LLU	Logical link up
LNA	Loop notify answer (Type 25 frame type)
NNB	No neighborhood state
OSI	Open systems interconnection
Ph-	Physical layer (as a prefix)
PhE	Ph-entity (the local active instance of the Physical layer)
PhL	Ph-layer
PhS	Ph-service
PLD	Physical link down
PLU	Port A (B) link up state
QoS	Quality-of-service
RCL	Ring control
RCLC	RCL communication control
RHE	Rapid hello (Type 25 frame type)
RT	Real time
RTC	RT communication control
SCR	Station condition report (Type 25 frame type)
TRC	Transmit/Receive control
WLU	Wait link up state

1173

1174 **3.5 Common conventions**

1175 This standard uses the descriptive conventions given in ISO/IEC 10731.

1176 The service model, service primitives, and time-sequence diagrams used are entirely abstract
1177 descriptions; they do not represent a specification for implementation.

1178 Service primitives, used to represent service user/service provider interactions (see ISO/IEC
1179 10731), convey parameters that indicate information available in the user/provider interaction.

1180 This standard uses a tabular format to describe the component parameters of the DLS
1181 primitives. The parameters that apply to each group of DLS primitives are set out in tables
1182 throughout the remainder of this standard. Each table consists of up to six columns,
1183 containing the name of the service parameter, and a column each for those primitives and
1184 parameter transfer directions used by the DLS:

- 1185 • the request primitive's input parameters;
- 1186 • the request primitive's output parameters;
- 1187 • the indication primitive's output parameters;
- 1188 • the response primitive's input parameters;
- 1189 • the confirm primitive's output parameters.

1190 NOTE The request, indication, response and confirm primitives are also known as requestor.submit,
1191 acceptor.deliver, acceptor.submit, and requestor.deliver primitives, respectively (see ISO/IEC 10731).

1192

1193 One parameter (or part of it) is listed in each row of each table. Under the appropriate service
1194 primitive columns, a code is used to specify the type of usage of the parameter on the
1195 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.

1196

1197 Some entries are further qualified by items in brackets. These may be

1198 a) 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;

1199 b) an indication that some note applies to the entry

(n) indicates that the following note n contains additional information pertaining to the
parameter and its use.

1200

1201 In any particular interface, not all parameters need be explicitly stated. Some may be
1202 implicitly associated with the DLSAP at which the primitive is issued.

1203 In the diagrams which illustrate these interfaces, dashed lines indicate cause-and-effect or
1204 time-sequence relationships, and wavy lines indicate that events are roughly
1205 contemporaneous.

1206 3.6 Additional Type 25 conventions

1207 3.6.1 Primitive conventions

1208 The following notation, a shortened form of the primitive classes defined in 3.2, is used in the
1209 figures.

1210 **req** request primitive
1211 **ind** indication primitive
1212 **cnf** confirm primitive (confirmation)
1213 **rsp** response primitive

3.6.2 State machine conventions

The protocol sequences are described by means of state machines.

In state diagrams, states are represented as boxes and state transitions are shown as arrows.

Names of states and transitions of the state diagram correspond to the names in the state table. The textual listing of the state transitions is structured as shown in Table 1.

Table 1 – State transition descriptions

#	Current state	Event /condition => actions	Next state
---	---------------	-----------------------------------	------------

Table 2 – Descriptions of state machine elements

Description element	Meaning
#	Number of the transition.
Current state, Next state	Names of the originating state and the target state of transition.
Event	Name or description of the trigger event that fire the transition.
/conditions	Boolean expression, which must be true for the transition to be fired.
=>actions	List of assignments and service or function invocations. The action should be atomic. The preceding "=>" is not part of the action.
NOTE: "*/ conditions" may be omitted	

The conventions used in the state machines are shown in Table 3.

Table 3 – Conventions used in state machine

Convention	Meaning
=	Substitution of the right side for the left side
==	A logical condition to indicate an item on the left is equal to an item on the right.
!=	A logical condition to indicate an item on the left is not equal to an item on the right
<	A logical condition to indicate an item on the left is less than the item on the right
>	A logical condition to indicate an item on the left is greater than the item on the right
&&	Logical "AND"
	Logical "OR"
!	Negation operator
+ - * /	Arithmetic operator
++	Increment operator
--	Decrement operator
;	Breakpoint

4 Overview of the DL-protocol

4.1 General

A type 25 fieldbus is based on the ISO/IEC 8802-3 standard but extended towards real-time Ethernet. Type 25 network controls the data traffic and assigns frame priorities with IEEE 802.1Q VLAN.

Note Any standard Ethernet silicon, infrastructure component or test and measurement equipment such as a network analyzer is applicable to type 25 network.

4.2 Overview of the medium access control

4.2.1 General

Type 25 network provides mechanisms to achieve the following.

- It assigns priorities to four types of frames (RCL/Cyclic/Control/Information).
- The frames in type 25 network are guaranteed real-time of cyclic communication to control the data traffic.
- It uses ISO/IEC 8802-3 standard communication without needs for special functions for RTE communication such as time sharing or node synchronization.
- The ring topology is only permitted in type 25 network. In order to control the network, it categorizes the frames into three classes according to their communication ranges.

4.2.2 Network topology

The ring topology shall be use in type 25 network. The network shall be controled and reconfigured by RCL frames. Type 25 ring network does not need concept of master/slave model because each node in type 25 network reconfigures autonomously. To prevent frame loop, one section in the ring network is in the blocking state (IEEE 802.1D) and the blocked section terminates all kinds of frames except RCL frame (as illustrated in Table 2).

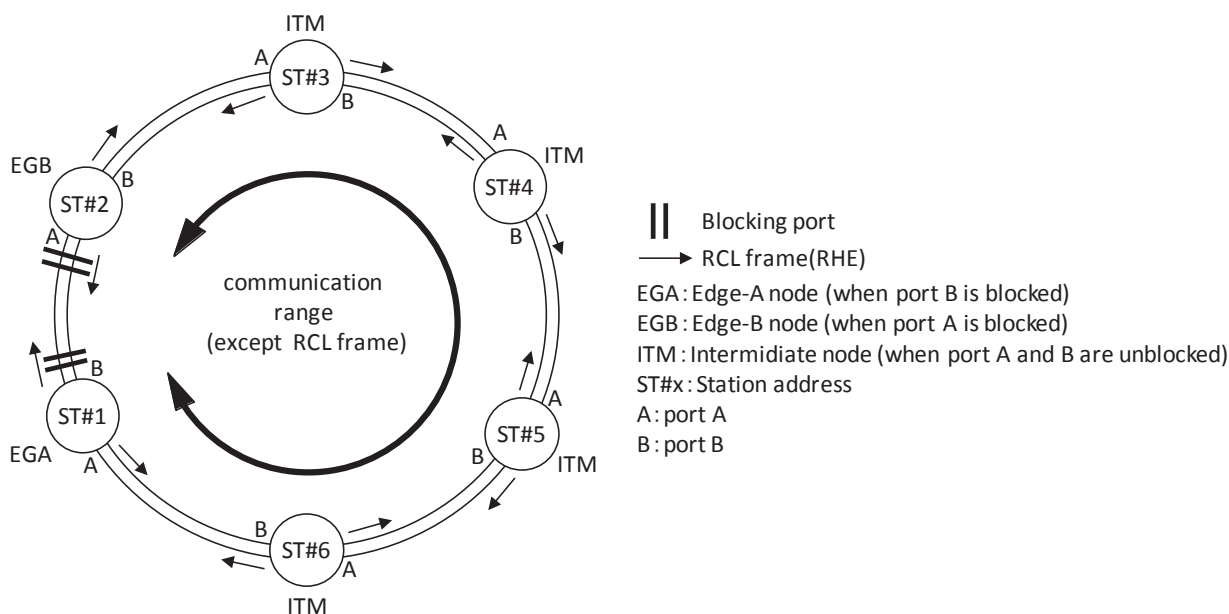


Figure 2 – Ring control in Type 25 network

Each node in the ring network has two ports A and B to connect to the neighboring nodes. Each node has its own station address. In type 25 network, each node has four different node states depending on the blocking status of their ports. Table 4 shows the characteristics of the node states.

Table 4 – Characteristics of the node states

Node states	Abbreviation	Description
Isolated node	ISL	Both port A and B are blocked in this state (e.g. not connect cables to other nodes) and the node is isolated from the type 25 network.

Node states	Abbreviation	Description
Edge-A node (when port B is blocked)	EGA	Port B is blocked, port A is unblocked. The node works with Edge-A. There is only one node in a Type 25 network.
Edge-B node (when port A is blocked)	EGB	Port A is blocked, port B is unblocked. The node works with Edge-B. There is only one node in a Type 25 network.
Intermediate node (when port A, B are unblocked)	ITM	Both port A and B are unblocked. The node works with Edge-A and Edge-B. In a Type 25 network, there are an Edge-A node and an Edge-B node. The other nodes are this state.

RCL frames are based on general ISO/IEC 8802-3 frames. These frames have different ranges of communication which are given by “class”. Table 5 shows the characteristics of the frame class and Figure 3 shows the communication ranges in Type 25 network.

Table 5 – Characteristic of the frame classes

Frame class	Description
Class 1	This frame is used to communicate with the neighboring node only. It passes through blocking ports. RHE frame are RCL frames in this class.
Class 2	This frame is used to communicate around the network. This frame is able to pass through blocking ports and the Edge-A node terminates the frames. LCC, LCA, LCN, LNA, and SCR frames are RCL frames in this class.
Class 3	This frame is general Ethernet frame and terminated by blocking ports. The RT frames (Cyclic, Control, Information frames) are in this class.

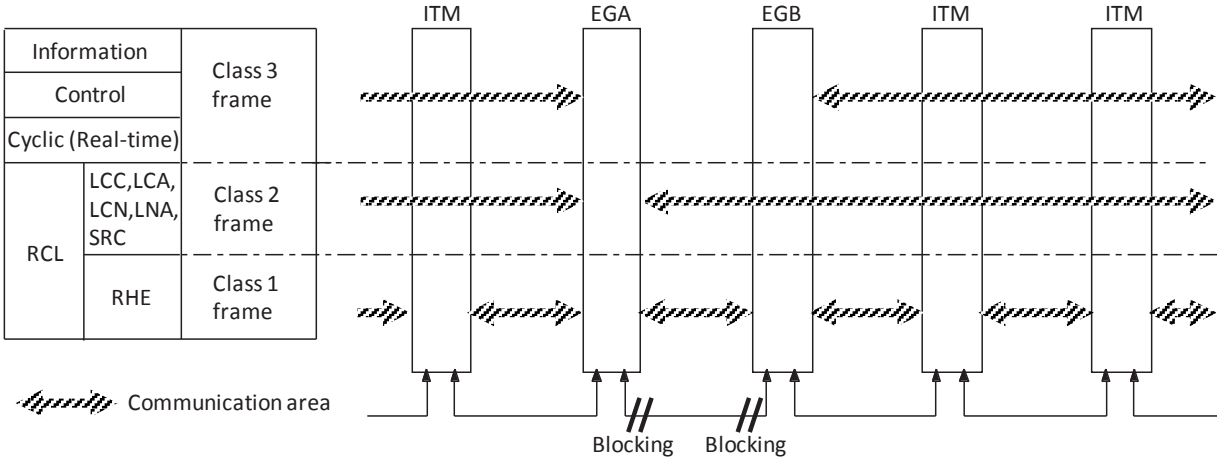


Figure 3 – Communication ranges of Type 25 frames

4.2.3 Priority control with VLAN

The Type 25 fieldbus has a medium access control with VLAN priority in order to provide the real-time communication. Figure 4 shows the mechanism of priority control with VLAN of the Type 25 fieldbus.

- VLAN-1: RCL communication

VLAN-2: Cyclic communication

VLAN-3: Control communication

VLAN-4: Information communication
- Priority

High

↑

Low

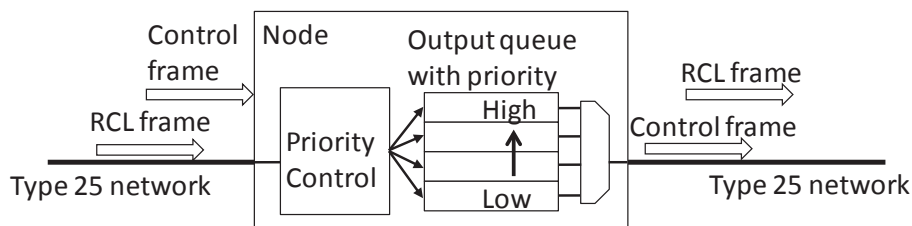


Figure 4 – Priority control with VLAN of Type 25 network

Each node has output queues with priority. The receiving frames are put into the output queues based on their frame priorities. The frame with higher priority will be forwarded neighboring node. In this mechanism, Type 25 network guarantees real-time cyclic communication.

4.2.4 The maximum delivery delay in Type 25 network

Type 25 network limits data traffic in the network to ensure real time communication. This maintains the communication delay of frames at an acceptable level. The traffic restriction of each node is determined by the total number of nodes in the network and cycle time using the node.

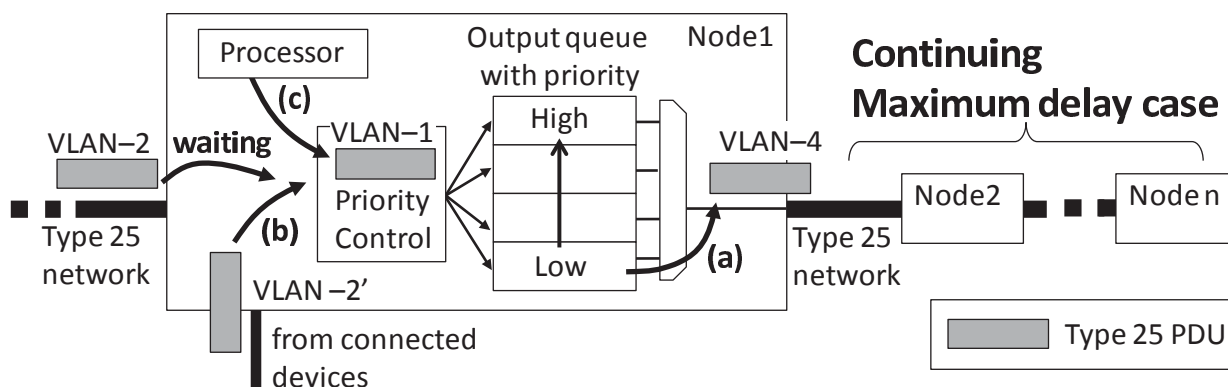


Figure 5 – The mechanism of transmission delay in a node

There are three causes of the delay regarding VLAN-2 (cyclic communication) frame in Type 25 network.

- VLAN-2 frame arrives at the time when the node is sending another frame. The VLAN-2 frame is forced to wait until the transmission is finished. This delay is caused by any priority frames.
- Before receiving a VLAN-2 frame, the node receives another VLAN-2 frame (VLAN-2' in Figure 5) from other ports. In this case, at the priority queue the VLAN2 frame is put after the VLAN-2' frame.
- When the VLAN-2 frame is waiting for transmission due to the causes a) and b), the node receives higher priority frames (VLAN-1 frame). Since the node will transmit the highest priority frames first, the VLAN-2 frame is forced to wait until the transmission of higher priority frames are finished.

When three causes happen all at once in a node, the maximum delay occurs. The delivery time could be calculated in the case of the maximum delay occurring at all nodes in a Type 25 network.

4.2.5 Traffic control for real-time communication

Delivery time in Type 25 network is calculated based on the maximum delay time per node, the number of nodes, and the length of ring network.

1312 The maximum delay of real-time communication (cyclic communication) between two nodes is
 1313 calculated by taking into account the four delay causes shown in Figure 6. The detail of each
 1314 cause is shown in IEC 61784-2 Profile 20/1.

1315 (1) Stacking delay in sending node:

1316 The delay caused by the transmission process. It depends on the implementation of
 1317 the hardware and software.

1318 (2) Cable segment delay:

1319 The delay caused by transmission cable constructing ring network. It is proportional
 1320 to the cable length.

1321 (3) Transmission delay in transit node

1322 The delay caused by transmission delay per transit node. It is proportional to the
 1323 number of nodes in the transmission path. The detail is shown in 4.2.4.

1324 (4) Stacking delay in receiving node:

1325 The delay caused by the receiving process. It depends on the implementation of the
 1326 hardware and software.

1327
 1328 The delivery time is calculated by the following equation.

1329 $(\text{delivery time}) = (1) + (2) \times \text{cable length} + (3) \times (\text{the number of nodes} - 2) + (4)$

1330 The cycle time of cyclic communication shall be set to larger than the delivery time to
 1331 guarantee real-time communication of cyclic communication frames in Type 25 network.

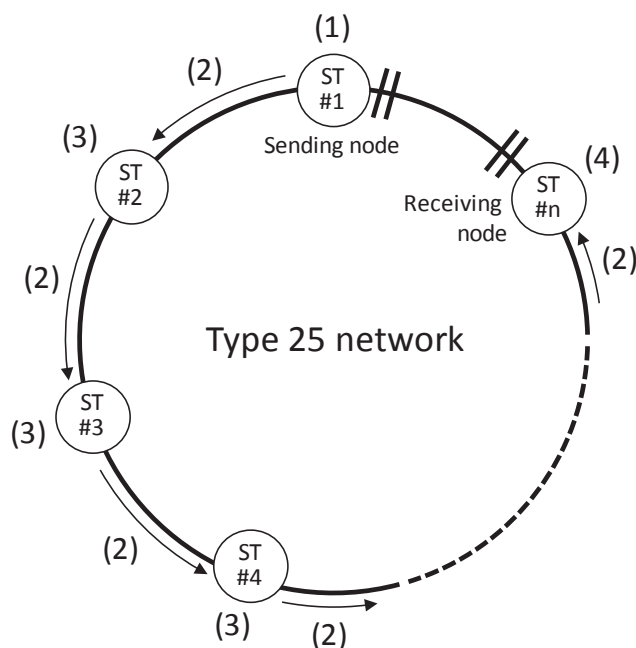


Figure 6 – The worst delay in Type 25 network

1332

1333

1334

1335 4.3 Service assumed from PhL

1336 This subclause describes the assumed physical service (PhS) and the constraints used by the
 1337 DLE. The Physical Service is assumed to provide the following service primitives specified by
 1338 ISO/IEC 8802-3, Clause 2.

1339 The assumed primitives of PhS are

1340 – PhS-A_DATA.req,

1341 – PhS-A_DATA.ind,

1342 – PhS-B_DATA.req,