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**Industrielle Kommunikationsnetze –
Feldbusse –
Teil 6-25: Protokollspezifikation des Application Layer
(Anwendungsschicht) – Typ 25-Elemente
(IEC 61158-6-25:2019);
Englische Fassung EN IEC 61158-6-25:2019, nur auf CD-ROM**

Industrial communication networks –
Fieldbus specifications –
Part 6-25: Application layer protocol specification – Type 25 elements
(IEC 61158-6-25:2019);
English version EN IEC 61158-6-25:2019, only on CD-ROM

Réseaux de communication industriels –
Spécifications des bus de terrain –
Partie 6-25: Spécification du protocole de la couche application – Eléments de type 25
(IEC 61158-6-25:2019);
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Anwendungsbeginn

Anwendungsbeginn für die von CENELEC am 2019-07-25 angenommene Europäische Norm als DIN-Norm ist 2020-08-01.

Nationales Vorwort

Vorausgegangener Norm-Entwurf: E DIN EN 61158-600:2017-12.

Dieser Entwurf betrifft auch die Normen DIN EN IEC 61158-6-2:2020-08, DIN EN IEC 61158-6-3:2020-08, DIN EN IEC 61158-6-4:2020-08, DIN EN IEC 61158-6-10:2020-08, DIN EN IEC 61158-6-12:2020-08, DIN EN IEC 61158-6-19:2020-08, DIN EN IEC 61158-6-21:2020-08, DIN EN IEC 61158-6-23:2020-08 und DIN EN IEC 61158-6-26:2020-08.

Für dieses Dokument ist das nationale Arbeitsgremium K 956 „Industrielle Kommunikation“ 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 die vorliegende Norm erfüllt.

Da sich die Benutzer der vorliegenden Norm der englischen Sprache als Fachsprache bedienen, wird die Englische Fassung der EN IEC 61158-6-25 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt und Abschnitt 3 (außer Unterabschnitte 3.3 und 3.4), der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA der vorliegenden Norm hinzugefügt. Für die meisten der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Diese Norm steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

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.

Ein Feldbus ist ein digitaler serieller Datenbus für die Kommunikation zwischen Geräten der industriellen Automatisierungstechnik wie beispielsweise Messeinrichtungen, Stellgliedern, Reglern und speicherprogrammierbaren Steuerungen. Die Normen der Reihe DIN EN IEC 61158 legen eine Anzahl von Feldbus-Protokolltypen fest. Die vorliegende Norm legt die Dienste fest, die durch den Data-Link Layer der einzelnen Typen zur Verfügung gestellt werden.

Nationaler Anhang NA (informativ)

Auszugsweise Übersetzung

Reihenfolge und Inhalt der folgenden Abschnitte sind identisch mit denen in den jeweiligen Abschnitten der Englischen Fassung.

EINLEITUNG

Dieser Teil von IEC 61158 gehört zu einer Normenreihe, die zur Erleichterung der Verbindung von Komponenten von Automatisierungssystemen erstellt wurde. Er ist mit anderen Normen der Reihe verbunden, wie durch das in IEC 61158-1 beschriebene „dreischichtige“ Feldbus-Referenzmodell definiert.

Das Anwendungsprotokoll stellt den Anwendungsdienst bereit, indem es die Dienste nutzt, die über die Datenverbindung oder eine andere unmittelbar darunter liegende Schicht verfügbar sind. Das vorrangige Ziel dieses Dokuments ist es, eine Reihe von Regeln für die Kommunikation zu erstellen, die sich auf die Verfahren beziehen, die von den Peer Application Entities (AE) zum Zeitpunkt der Kommunikation durchzuführen sind. Diese Regeln für die Kommunikation sollen eine stabile Grundlage für die Weiterentwicklung bilden, damit sie einer Vielzahl von Zwecken dienen können:

- als Leitfaden für Implementierer und Konstrukteure;
- zur Verwendung bei der Prüfung und Beschaffung von Ausrüstung;
- als Teil einer Vereinbarung über die Zulassung von Systemen in der offenen Systemumgebung;
- als eine Erweiterung des Verständnisses von zeitkritischer Kommunikation innerhalb der OSI.

Dieses Dokument befasst sich insbesondere mit der Kommunikation und dem Zusammenwirken von Sensoren, Effektoren und anderen Automatisierungsgeräten. Durch die Verwendung dieses Dokuments zusammen mit anderen Normen, die innerhalb der OSI- oder Feldbus-Referenzmodelle vorhanden sind, können andernfalls inkompatible Systeme in beliebiger Kombination zusammenarbeiten.

1 Anwendungsbereich

1.1 Allgemeines

Der Feldbus Application Layer (FAL, en: Fieldbus Application Layer) stellt Anwenderprogramme mit Mitteln zum Zugriff auf die Feldbuskommunikationsumgebung bereit. Insofern kann der FAL als ein „Fenster zwischen entsprechenden Anwendungsprogrammen“ angesehen werden.

Diese Internationale Norm legt allgemeine Elemente für grundlegende zeitkritische und nicht zeitkritische Messaging-Kommunikationen zwischen Anwendungsprogrammen in einem Automatisierungsumfeld und für Typ-25-Feldbusse spezifisches Material fest. Der Begriff „zeitkritisch“ wird zum Angeben des Vorhandenseins eines Zeitfensters, in dem eine oder mehrere festgelegte Aktionen mit einem gewissen definierten Sicherheitsgrad abzuschließen sind, verwendet. Das Nichtabschließen festgelegter Aktionen in dem Zeitfenster birgt das Risiko eines Ausfalls der Anwendungen, die die Aktionen anfordern, zusammen mit einem begleitenden Risiko für Betriebsmittel, die Anlage und möglicherweise Menschenleben.

Dieses Dokument definiert auf abstrakte Art und Weise das nach außen erkennbare Verhalten, das durch die verschiedenen Typen des Feldbus Application Layer bereitgestellt wird, hinsichtlich

- a) der abstrakten Syntax, die die zwischen kommunizierenden Anwendungsinstanzen übermittelten Application Layer-Protokolldateneinheiten definiert,
- b) der Übertragungssyntax, die die zwischen kommunizierenden Anwendungsinstanzen übermittelten Application Layer-Protokolldateneinheiten definiert,

- c) des Anwendungskontextzustandsautomaten, der das zwischen kommunizierenden Anwendungsinstanzen erkennbare Anwendungsdienstverhalten definiert und
- d) der Anwendungsbeziehungszustandsautomaten, die das zwischen kommunizierenden Anwendungsinstanzen erkennbare Kommunikationsverhalten definieren.

Der Zweck dieses Dokuments ist es, das Protokoll zu definieren, das bereitgestellt wird, um

- a) die Drahtdarstellung der in IEC 61158-5-25 definierten Dienstprimitive zu definieren und
- b) das nach außen erkennbare Verhalten zu definieren, das im Zusammenhang mit der entsprechenden Übertragung steht.

Dieses Dokument legt das Protokoll der IEC-Feldbus Application Layer in Übereinstimmung mit dem OSI-Basisreferenzmodell (ISO/IEC 7498-1) und der OSI-Anwendungsschichtstruktur (ISO/IEC 9545) fest.

FAL-Dienste und Protokolle werden durch FAL-Anwendungsinstanzen (AE, en: application entities), die in den Anwendungsprozessen enthalten sind, bereitgestellt. Die FAL-AE besteht aus einem Satz objektorientierter Anwendungsdienstelemente (ASE, en: Application Service Elements) und einer Einheit für Schichtenmanagement (LME, en: Layer Management Entity), die die AE verwaltet. Die ASE stellen Kommunikationsdienste bereit, die auf einem Satz zugehöriger Anwendungsprozessobjekt-(APO)-Klassen operieren. Eines der FAL-ASE ist ein Management-ASE, das einen gemeinsamen Satz von Diensten für die Verwaltung der Instanzen von FAL-Klassen bereitstellt.

Obwohl diese Dienste, aus dem Blickwinkel der Anwendung, beschreiben wie Anfrage und Antwort ausgegeben und abgegeben werden, beinhalten sie keine Festlegung was die anfragende und antwortende Anwendungen mit diesen vorzunehmen haben. Die Verhaltensaspekte der Anwendungen sind nicht festgelegt, nur eine Definition von welchen Anfragen und Antworten diese senden/empfangen können, ist beschrieben. Dies erlaubt den FAL-Benutzern eine größere Flexibilität, um solch ein Objektverhalten zu standardisieren. Zusätzlich zu diesen Diensten, sind in dieser Norm ebenfalls einige Dienste zur Unterstützung festgelegt, um den Zugriff zum FAL bereitzustellen und somit bestimmte Aspekte des Betriebs zu steuern.

1.2 Spezifikationen

Das wesentliche Ziel dieses Dokuments ist es, die Syntax und das Verhalten des Application Layer-Protokolls, das die in IEC 61158-5-25 definierten Application Layer-Dienste übermittelt, festzulegen. Ein Nebenziel ist es, Migrationspfade von zuvor bestehenden industriellen Kommunikationsprotokollen bereitzustellen. Es ist dieses letztgenannte Ziel, das zu der Vielfalt von in Unterteilen von IEC 61158-6 genormten Protokollen führt.

1.3 Konformität

Dieses Dokument legt keine individuellen Implementierungen oder Produkte fest, noch beschränkt es die Implementierungen von Application Layer-Instanzen in industriellen Automatisierungssystemen.

Es gibt keine Betriebsmittelkonformität betreffend dieser Application Layer-Dienstdefinitionsnorm. Stattdessen wird Konformität durch Implementierung dieser Application Layer-Protokollspezifikation erreicht.

3 Begriffe, Symbole und Abkürzungen

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe, Symbole, Abkürzungen und Vereinbarungen.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- IEC Electropedia: verfügbar unter <http://www.electropedia.org/>
- ISO Online Browsing Platform: verfügbar unter <http://www.iso.org/obp>

3.1 Begriffe für Referenzmodell

3.1.1 Begriffe nach ISO/IEC 7498-1

Für die Anwendung dieses Dokuments gelten die folgenden in ISO/IEC 7498-1 angegebenen Begriffe:

- Anwendungsinstantz (en: application entity)
- Anwendungsprozess (en: application process)
- Anwendungsprotokolldateneinheit (en: application protocol data unit)
- Anwendungsdienstelement (en: application service element)
- Aufruf einer Anwendungsinstantz (en: application entity invocation)
- Aufruf eines Anwendungsprozesses (en: application process invocation)
- Anwendungstransaktion (en: application transaction)
- reales offenes System (en: real open system)
- Übertragungssyntax (en: transfer syntax)

3.1.2 Begriffe nach ISO/IEC 8822

Für die Anwendung dieses Dokuments gelten die folgenden in ISO/IEC 8822 angegebenen Begriffe:

- a) abstrakte Syntax (en: abstract syntax)
- b) Darstellungskontext (en: presentation context)

3.1.3 Begriffe nach ISO/IEC 9545

Für die Anwendung dieses Dokuments gelten die folgenden in ISO/IEC 9545 angegebenen Begriffe:

- a) Anwendungsassoziation (en: application-association)
- b) Anwendungskontext (en: application-context)
- c) Anwendungskontextname (en: application context name)
- d) Anwendungsinstanzzaufruf (en: application-entity-invocation)
- e) Anwendungsinstanztyp (en: application-entity-type)
- f) Anwendungsprozessaufruf (en: application-process-invocation)
- g) Anwendungsprozessstyp (en: application-process-type)
- h) Anwendungsdienstelement (en: application-service-element)
- i) Anwendungssteuerdienstelement (en: application control service element)

3.1.4 Begriffe nach ISO/IEC 8824-1

Für die Anwendung dieses Dokuments gelten die folgenden in ISO/IEC 8824-1 angegebenen Begriffe:

- a) Objektbezeichner (en: object identifier)
- b) Typ (en: type)

3.2 Zusätzliche Typ-25-Begriffe

Für die Anwendung dieses Dokuments gelten auch die folgenden Definitionen.

ANMERKUNG Viele Definitionen treffen auf mehr als einen Protokoll-Typ zu; sie werden nicht zwangsweise von allen Protokoll-Typen verwendet.

3.2.1

ADP-Nachricht

(en: ADP message)

über ein eigenständiges dezentralisiertes Systemprotokoll übermittelte Nachricht

3.2.2

Lebenszeichen-Nachricht

(en: alive-message)

regelmäßig übertragene Nachricht, die den eigenen Knotenzustand meldet

3.2.3

Block

(en: block)

grundlegende Einheit von in einer zyklischen Kommunikation übertragenen Daten, wobei jede eine Größe von 64 Oktetten hat

3.2.4

Kategorie N_f

(en: category N_f)

Kategorie eines eigenständigen dezentralisierten Systemprotokolls nach Typ N mit allen Spezifikationen

3.2.5

Kategorie N_l

(en: category N_l)

Kategorie eines eigenständigen dezentralisierten Systemprotokolls nach Typ N mit leichten Spezifikationen

3.2.6

Steuerungskommunikation

(en: control communication)

azyklische Datenkommunikation für stark zeitkritische Anwendungen in Typ-S-Netzwerken

3.2.7

zyklische Kommunikation

(en: cyclic communication)

periodische Datenkommunikation für Echtzeitkommunikation

3.2.8

Speicher für zyklische Übertragung

(en: cyclic transfer memory)

Speicher, der jedem Knoten in dem Datenfeld zugeordnet ist, wobei jeder Knoten zum Zweck des logischen Teilens dieses Speicherbereichs periodisch überträgt

3.2.9

Datenfeld

(en: data field)

logischer Ort, durch den spezifische Daten laufen, realen Netzwerken entsprechend

3.2.10

Domäne

(en: domain)

Verwaltungssatz, der aus mehreren Datenfeldern besteht

3.2.11

Duplex-LAN

(en: duplex LAN)

zwei verschiedene Netzwerkpfade zwischen Endknoten

3.2.12

Betriebsmittel

(en: equipment)

physische Hardware, die mit dem Netzwerk verbunden ist

BEISPIEL Station, Gerät und Server.

3.2.13**Informationskommunikation**

(en: information communication)

azyklische Datenkommunikation für weniger zeitkritische Anwendungen in Typ-S-Netzwerken

3.2.14**logischer Knoten**

(en: logical node),

Knoten

(en: node)

Betriebsmittel in Datenfeldern, wo die Funktion eines eigenständigen dezentralisierten Systems installiert ist

3.2.15**Nachrichtenmodus**

(en: message mode)

Kennung, die die Verwendungen einer Nachricht angibt (ob Online-Nachricht oder Test-Nachricht)

BEISPIEL Online-Nachricht oder eine Test-Nachricht.

3.2.16**Multicast-Gruppe**

(en: multicast group)

Gruppe von Knoten, die zu einem Datenfeld gehören, zur Bestimmung, ob dieselben Daten von einem anderen Knoten zu empfangen sind

3.2.17**Knotenliste**

(en: node list)

Bit-Array-Struktur zum Festlegen eines Knotens, der Anforderungsdaten empfangen soll

3.2.18**Knotenmodus**

(en: node mode)

Kennung, die die Verwendung eines Knotens angibt

BEISPIEL Online-Knoten oder ein Test-Knoten.

3.2.19**primäres lokales Netz**

(en: primary local area network)

lokales Netz (LAN), das im Normalzustand in einem Duplex-LAN-System verwendet wird

3.2.20**Prioritätssteuerung**

(en: priority control)

Steuern der Übertragungsreihenfolge für die aus den Netzwerken ankommenden Pakete, entsprechend dem virtuellen lokalen Netz (VLAN, en: virtual local area network)

3.2.21**Ringsteuerungs-Kommunikation**

(en: ring control communication)

Steuerungsringnetzwerk von Typ-S-Netzwerken unter Verwendung von Ringsteuerungs-(RCL)-Rahmen

3.2.22**Fernsteuerung**

(en: remote control)

Steuerung für andere Knoten, die an ein Netzwerk angeschlossene sind

3.2.23

sekundäres lokales Netz

(en: secondary local area network)

lokales Netz (LAN) für das Backup eines primären LAN in einem Duplex-LAN-System

3.2.24

Transaktionscode

(en: transaction code)

Informationen zum Identifizieren der Merkmale der Nachricht innerhalb einer PDU

English Version

**Industrial communication networks - Fieldbus specifications -
Part 6-25: Application layer protocol specification -
Type 25 elements
(IEC 61158-6-25:2019)**

Réseaux de communication industriels - Spécifications des
bus de terrain - Partie 6-25: Spécification du protocole de la
couche application - Eléments de type 25
(IEC 61158-6-25:2019)

Industrielle Kommunikationsnetze - Feldbusse -
Teil 6-25: Protokollspezifikation des Application Layer
(Anwendungsschicht) - Typ 25-Elemente
(IEC 61158-6-25:2019)

This European Standard was approved by CENELEC on 2019-07-25. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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

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European foreword

The text of document 65C/948/FDIS, future edition 1 of IEC 61158-6-25, 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 approved by CENELEC as EN IEC 61158-6-25:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by (dop) 2020-04-25
publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2022-07-25
document have to be withdrawn

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Endorsement notice

The text of the International Standard IEC 61158-6-25:2019 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 61158-1	NOTE	Harmonized as EN IEC 61158-1.
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Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61158-3-25	2019	Industrial communication networks - Fieldbus specifications - Part 3-25: Data-link layer service definition - Type X elements	EN IEC 61158-3-25	2019
IEC 61158-5-25	2019	Industrial communication networks - Fieldbus specifications - Part 5-25: Application layer service definition - Type 25 elements	EN IEC 61158-5-25	2019
ISO/IEC 7498-1	-	Information technology - Open Systems Interconnection - Basic reference model: The basic model	-	-
ISO/IEC 8822	-	Information technology - Open Systems Interconnection - Presentation service definition	-	-
ISO/IEC 9545	-	Information technology - Open Systems Interconnection - Application layer structure	-	-
ISO/IEC 8824-1	-	Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation	-	-
ISO/IEC/IEEE 8802-3	-	Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Standard for Ethernet	-	-
IEEE 802.1D	-	IEEE Standard for local and metropolitan area networks - Media Access Control (MAC) Bridges	-	-
IEEE 802.1Q	-	IEEE Standard for Local and metropolitan area networks - Media Access Control (MAC) Bridges and Virtual Bridges	-	-
IETF RFC 768	-	User Datagram Protocol	-	-
IETF RFC 791	-	Internet Protocol - DARPA Internet Program Protocol Specification	-	-

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INTRODUCTION

This document 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 61158-1.

The application protocol provides the application service by making use of the services available from the data-link or other immediately lower layer. The primary aim of this document is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer application entities (AEs) 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:

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

This document is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this document 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 6-25: Application layer protocol specification – Type 25 elements

1 Scope

1.1 General

The Fieldbus Application Layer (FAL) provides user programs with a means to access the fieldbus communication environment. In this respect, the FAL can be viewed as a “window between corresponding application programs.”

This International Standard provides common elements for basic time-critical and non-time-critical messaging communications between application programs in an automation environment and material specific to Type 25 fieldbus. 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 document defines in an abstract way the externally visible behavior provided by the different Types of the fieldbus Application Layer in terms of:

- a) the abstract syntax defining the application layer protocol data units conveyed between communicating application entities,
- b) the transfer syntax defining the application layer protocol data units conveyed between communicating application entities,
- c) the application context state machine defining the application service behavior visible between communicating application entities; and
- d) the application relationship state machines defining the communication behavior visible between communicating application entities.

The purpose of this document is to define the protocol provided to:

- a) define the wire-representation of the service primitives defined in IEC 61158-5-25, and
- b) define the externally visible behavior associated with their transfer.

This document specifies the protocol of the IEC fieldbus Application Layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498-1) and the OSI Application Layer Structure (ISO/IEC 9545).

FAL services and protocols are provided by FAL application-entities (AE) contained within the application processes. The FAL AE is composed of a set of object-oriented Application Service Elements (ASEs) and a Layer Management Entity (LME) that manages the AE. The ASEs provide communication services that operate on a set of related application process object (APO) classes. One of the FAL ASEs is a management ASE that provides a common set of services for the management of the instances of FAL classes.

Although these services specify, from the perspective of applications, how request and responses are issued and delivered, they do not include a specification of what the requesting and responding applications are to do with them. That is, the behavioral aspects of the applications are not specified; only a definition of what requests and responses they can send/receive is specified. This permits greater flexibility to the FAL users in

standardizing such object behavior. In addition to these services, some supporting services are also defined in this document to provide access to the FAL to control certain aspects of its operation.

1.2 Specification

The principal objective of this document is to specify the syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-25. A secondary objective is to provide migration paths from previously-existing industrial communications protocols. It is this latter objective which gives rise to the diversity of protocols standardized in subparts of IEC 61158-6.

1.3 Conformance

This document does not specify individual implementations or products, nor does it constrain the implementations of application layer entities within industrial automation systems.

There is no conformance of equipment to the application layer service definition standard. Instead, conformance is achieved through implementation of this application layer protocol specification.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE All parts of the IEC 61158 series, as well as IEC 61784-1 and IEC 61784-2 are maintained simultaneously. Cross-references to these documents within the text therefore refer to the editions as dated in this list of normative references.

IEC 61158-3-25:2019, *Industrial communication networks – Fieldbus specifications – Part 3-25: Data-link layer service definition – Type 25 elements*

IEC 61158-5-25:2019, *Industrial communication networks – Fieldbus specifications – Part 5-25: Application layer service definition – Type 25 elements*

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

ISO/IEC 8822, *Information technology – Open Systems Interconnection – Presentation service definition*

ISO/IEC 9545, *Information technology – Open Systems Interconnection – Application Layer structure*

ISO/IEC 8824-1, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/IEC/IEEE 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Standard for Ethernet*

IEEE Std 802.1D, *IEEE Standard for Local and metropolitan area networks – Media access Control (MAC) Bridges*; available at <http://www.ieee.org> [viewed 2018-09-17]

IEEE Std 802.1Q, *IEEE Standard for Local and metropolitan area networks – Bridges and Bridged Networks*; available at <http://www.ieee.org> [viewed 2018-09-17]

IETF RFC 768, *User Datagram Protocol*; available at <http://www.ietf.org> [viewed 2018-09-17]

IETF RFC 791, *Internet Protocol*; available at <http://www.ietf.org> [viewed 2018-09-17]

3 Terms, definitions, symbols, abbreviations and conventions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Reference model terms and definitions

3.1.1 ISO/IEC 7498-1 terms

For the purposes of this document, the following terms given in ISO/IEC 7498-1 apply:

application entity;
application process;
application protocol data unit;
application service element;
application entity invocation;
application process invocation;
application transaction;
real open system;
transfer syntax.

3.1.2 ISO/IEC 8822 terms

For the purposes of this document, the following terms given in ISO/IEC 8822 apply:

a) abstract syntax;
presentation context.

3.1.3 ISO/IEC 9545 terms

For the purposes of this document, the following terms given in ISO/IEC 9545 apply:

a) application-association;
application-context;
application context name;
application-entity-invocation;
application-entity-type;
application-process-invocation;
application-process-type;
application-service-element;
application control service element.

3.1.4 ISO/IEC 8824-1 terms

For the purposes of this document, the following terms given in ISO/IEC 8824-1 apply:

a) object identifier;
type.

3.2 Additional Type 25 terms and definitions

For the purpose of this document, the following definitions also apply.

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

3.2.1

ADP message

message conveyed by an autonomous decentralized system protocol

3.2.2

alive-message

message reporting own node state, periodically transmitted

3.2.3

block

basic unit of data transferred in a cyclic communication, each having a size of 64 octets

3.2.4

category N_f

category of an autonomous decentralized system protocol (full specifications) in type N

3.2.5

category N_l

category of an autonomous decentralized system protocol (light weight specifications) in type N

3.2.6

control communication

acyclic data communication for higher time-critical applications in type S network

3.2.7

cyclic communication

periodic data communication for real-time communication

3.2.8

cyclic transfer memory

memory which is allocated to each node in the data field, which each node transmits periodically for the purpose of sharing of this memory area logically

3.2.9

data field

logical place through which specific data passes, corresponding to real networks

3.2.10

domain

administrative set consisting of multiple data fields

3.2.11

duplex LAN

two different network-paths between end nodes

3.2.12

equipment

physical hardware connected to the network

EXAMPLE Station, device, and server.

3.2.13

information communication

acyclic data communication for lower time-critical application in type S network

3.2.14

logical node, node

equipment in data fields, where an autonomous decentralized system's function is installed

3.2.15

message mode

identifier that indicates the uses of a message (whether an online message or a test message)

EXAMPLE Online message or a test message.

3.2.16

multicast group

group of nodes belonging to a data field to determine whether to receive same data from other node

3.2.17

node list

bit array structure of specifying a node to receive a request data

3.2.18

node mode

identifier that indicates the usage of a node

EXAMPLE Online node or a test node.

3.2.19

primary local area network

local area network (LAN) used in normal state in a duplex LAN system

3.2.20

priority control

transmission order control for the packets arrived from networks, according to the virtual local area network (VLAN)

3.2.21

ring control communication

control for the type S ring network using ring control (RCL) frames

3.2.22

remote control

control for other nodes connected to a network

3.2.23

secondary local area network

local area network (LAN) for backup of a primary LAN in a duplex LAN system

3.2.24

transaction code

information to identify the characteristics of the message within a PDU

3.3 Symbols and abbreviations

ADP	Autonomous Decentralized Protocol
ADS-net	Autonomous Decentralized System – network

AE	Application Entity
AL	Application Layer
AP	Application Process
APDU	Application Protocol Data Unit
APO	Application Process Object
AR	Application Relationship
AREP	Application Relationship Endpoint
ARPM	Application Relationship Protocol Machine
ASCII	American Standard Code for Information Interchange
ASE	Application Service Element
ASN.1	Abstract Syntax Notation 1
CRC	Cyclic Redundancy Check
DF	Data Field
Dfn	Data Field Number
DLL	Data-link Layer
Dmn	DoMain Number
DMPM	DLL Mapping Protocol Machine
DSCP	DiffServ Code Point
FAL	Fieldbus Application Layer
FSPM	FAL Service Protocol Machine
GMT	Greenwich Mean Time
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
LAN	Local area network
LCA	Loop condition alert (Type S frame type)
LCC	Loop condition check (Type S frame type)
LCN	Loop condition notify (Type S frame type)
LLD	Logical link down
LLU	Logical link up
LNA	Loop notify answer (Type S frame type)
Lnn	Logical Node Number
LSB	Least Significant Bit
MCG	MultiCast Group
Mgn	Multicast Group Number
MSB	Most Significant Bit
MTU	Maximum Transmission Unit
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
PLD	Physical link down
QoS	Quality-of-service
RCL	Ring control

RHE	Rapid hello (Type S frame type)
RMTCTL	Remote control
RT	Real time
SCR	Station condition report (Type S frame type)
TCD	Transaction CoDe
TCP	Transmission Control Protocol
TMID	Transfer Memory Identifier
UDP	User Datagram protocol

3.4 Conventions

3.4.1 General conventions

Conventions given in IEC 61158-3-25 are also applied in this document.

3.4.2 Conventions for class definitions

This description of FAL Type 25 uses a subset of ASN.1. The following structures are used. Selective type (CHOICE) – Represents a selection from candidate types.

Sequence type (SEQUENCE) – Represents a fixed-order list as in the following example:

```
DLPDU ::= SEQUENCE {
  preamble    Preamble,
  sfd         SFD,
  destaddr    DestAddr,
  srcaddr     SrcAddr,
  vlantag     VLANtag,
  lt          LT,
  dlsdu       FAL-PDU,
  fcs         FCS
}
```

NOTE This example shows that the DLPDU which represents the Ethernet frame is defined as SEQUENCE. The DLPDU consists of Preamble, SFD, DestAddr, SrcAddr, VLANtag, LT, FAL-PDU and FCS.

3.4.3 Conventions for bit description in octets

When identifying each bit in an octet, each bit is identified by a number as shown in Figure 1 and described as Bit n.

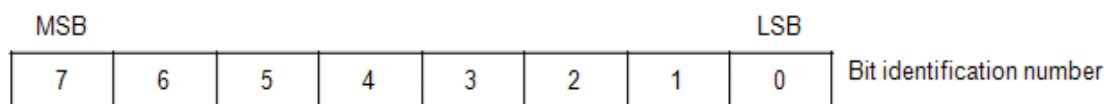


Figure 1 – Bit description in octets

When specifying multiple bits sequentially located, the range symbol (..) is used (e.g.: 7..0, specifies bits 7 through 0, inclusive).

When specifying multiple octets, the LSB of the lowest octet is assigned as 0, and bit identification numbers are assigned in an ascending order.

NOTE For example, when specifying 4 octets, the MSB of the highest octet is Bit 31, the MSB of the second octet is Bit 23, the MSB of the third octet is Bit 15, and the MSB of the lowest octet is Bit 7.

3.4.4 Conventions for state machine descriptions

The state machine description is defined in tabular form as shown in Table 1. The meanings of the elements are shown in Table 2. The conventions used in the state machines are shown in Table 3.

Each row of state table represents a state transition. The first column shows the state transition name or number. The second column shows the current state. The third column shows the events, conditions and actions. The fourth column shows the next state. When an event or condition is fulfilled, the action is performed and the state machine transits to the next state.

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 shall 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
"/ conditions" may be omitted.	

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
;	Breakpoint
++	Increment operator
--	Decrement operator

4 FAL syntax description

4.1 FAL PDU type S abstract syntax

4.1.1 Basic abstract syntax

The definitions of FALPDU are shown below.

```
FAL-PDU ::= CHOICE {  
    RCL-PDU,  
    RT-PDU  
}
```

```
RCL-PDU ::= CHOICE {  
    RHE-PDU,  
    LCC-PDU,  
    LCA-PDU,  
    LCN-PDU,  
    LNA-PDU,  
    SCR-PDU  
}
```

```
RT-PDU ::= CHOICE {  
    Cyclic_S-PDU,  
    CTL-PDU,  
    INFO-PDU  
}
```

```
CTL-PDU ::= CHOICE {  
    Control-PDU,  
    RMTCTL-PDU  
}
```

4.1.1.1 RCL-PDU

RCL_header to be used in each RCL-PDU is shown as follows.

```
RCL_header ::= SEQUENCE {  
    Frame Class          CLASS,  
    Dst Address          SEQUENCE {  
        Reserved1        Unsigned8,  
        DA_STaddress     ST_Address,  
        DA_MACaddress    MAC_Address  
    },  
    Src Address          SEQUENCE {  
        Reserved2        Unsigned8,  
        SA_STaddress     ST_Address,  
        SA_MACaddress    MAC_Address  
    },  
    RCL Command RCLCMD,  
    Frame Sequence      SequenceNum32,  
    Reserved3           OCTET STRING(SIZE 20)  
}
```

4.1.1.1.1 RHE-PDU

```

RHE-PDU ::= SEQUENCE {
    RCL_header          RCL_HEADER,
    RHE_header          SEQUENCE {
        RHE_Common SEQUENCE {
            Send Direction      PortNum,
            RHE Sequence        SequenceNum32
        },
        Neighborhood address SEQUENCE {
            Reserved1            Unsigned32,
            NB_STaddress         ST_Address,
            NB_MACaddress        MAC_Address
        },
        RHE ReceiveStatus       RHE_RxStatus,
        True Status             SEQUENCE {
            Reserved2            Unsigned32,
            Physical Linkdown    PLD,
            Reserved3            Unsigned32
        },
        Blocking Status         BLK_Status,
        Node Status             Node_Status,
        Reserved4               OCTET STRING(SIZE 20)
    },
    Reserved5              OCTET STRING(SIZE 64),
    RHE_pattern            SEQUENCE {
        RHE_pattern1           Pattern32,
        RHE_pattern2           Pattern32,
        RHE_pattern3           Pattern32,
        RHE_pattern4           Pattern32,
        .
        .
        .
    }
}

```

4.1.1.1.2 LCC-PDU

```

LCC-PDU ::= SEQUENCE {
    RCL_header          RCL_HEADER,
    LCC_header          SEQUENCE {
        LCC Kind          RCLKIND,
        LCC Priority       SEQUENCE {
            LCC_Priority   Priority,
            LCC_STadd      ST_Address,
            LCC_MACadd     MAC_Address
        },
        Reserved1         OCTET STRING(SIZE 52)
    }
}

```

4.1.1.1.3 LCA-PDU

```

LCA-PDU ::= SEQUENCE {
    RCL_header          RCL_HEADER,
    LCA_header          SEQUENCE {
        Reserved1        Unsigned32,
        RCL Status        RCL_Status,
        LCA Priority       SEQUENCE {
            LCA_Priority   Priority,
            LCA_STadd      ST_Address,
            LCA_MACadd     MAC_Address
        }
    }
}

```

```

    },
    Reserved2          OCTET STRING(SIZE 48)
  }
}

```

4.1.1.1.4 LCN-PDU

```

LCN-PDU ::= SEQUENCE {
    RCL_header      RCL_HEADER,
    LCN_header      SEQUENCE {
        Reserved1    Unsigned32,
        RCL_Status   RCL_Status,
        Reserved2    OCTET STRING(SIZE 56)
    }
}

```

4.1.1.1.5 LNA-PDU

```

LNA-PDU ::= SEQUENCE {
    RCL_header      RCL_HEADER,
    LNA_header      SEQUENCE {
        Reserved1    Unsigned32,
        RCL_Status   RCL_Status,
        Reserved2    OCTET STRING(SIZE 56)
    }
}

```

4.1.1.1.6 SCR-PDU

```

SCR-PDU ::= SEQUENCE {
    RCL_header      RCL_HEADER,
    SCR_header      SEQUENCE {
        Entry Number EntryNum,
        SendStat Time Send_Time,
        Reserved1    OCTET STRING(SIZE 52)
    },
    Event_info      SEQUENCE {
        Event0        EventData,
        Event1        EventData,
        .
        .
        .
        Event16       EventData
    }
}

```

4.1.1.2 RT-PDU

4.1.1.2.1 Cyclic_S-PDU

```

Cyclic_S-PDU ::= SEQUENCE {
    IP_header      IP_HEADER,
    UDP_header     UDP_HEADER,
    Reserved1      Unsigned16,
    Cyclic_header  CYCLIC_HEADER,
    Block_num      SEQUENCE {
        Block number1 BlockNum,
        Block number2 BlockNum,
        .
        .
        .
    }
}

```

```

        Block number21      BlockNum,
        BLock_num pattern   Pattern16
    },
    Cyclic_data              SEQUENCE {
        Block data1          BlockData,
        Block data2          BlockData,
        .
        .
        .
        Block data21         BlockData
    },
    Cyclic_FCS              CFCS
}

Cyclic_header ::= SEQUENCE {
    Cyclic_pattern          CYCLIC_PATTERN,
    Total_Block             TOTAL_BLOCK,
    Src STaddress ST_Address,
    Reserved1               Unsigned8
}

```

4.1.1.2.2 CTL-PDU

4.1.1.2.2.1 Control-PDU,

```

Control-PDU ::= SEQUENCE {
    IP_header              IP_HEADER,
    UDP_header             UDP_HEADER,
    CTL_data               CTLdata
}

```

4.1.1.2.2.2 RMTCTL-PDU

```

CTL_cyclic-PDU ::= SEQUENCE {
    IP_header              IP_HEADER,
    UDP_header             UDP_HEADER,
    RMTCTL_CMD SEQUENCE {
        Reserved1          Unsigned16,
        Header Type        HEADER_TYPE,
        Module ID           MODULE_ID,
        Station number ST_NUM,
        Command code        RMTCTL_CMD,
        Length              LENGTH,
        RMTCTL Status       STATUS,
        RMTCTL Kind         RMTKIND,
        RMTCTL Length       RMT_LENGTH,
        RMTCTL Address      RMT_ADD,
        Send Number         SND_NUM,
        Reserved1           Unsigned16,
        Reserved2           Unsigned32
    },
    RMTCTL data            RMTCTL_DATA
}

```

4.1.1.2.3 INFO-PDU

```

INFO-PDU ::= SEQUENCE {
    IP_header              IP_HEADER,
    UDP_header             UDP_HEADER,
    INFO_data              INFOData
}

```

4.2 FAL PDU type N abstract syntax

4.2.1 Basic abstract syntax

The definitions of FALPDU are shown below.

```
FAL-PDU ::= CHOICE {
    CyclicData-PDU [0] CyclicData-PDU ,
    MulticastData-PDU [1] MulticastData-PDU ,
    PtoP Data-PDU [2] PtoP Data-PDU ,
    Aliveinfo-PDU [3] Aliveinfo-PDU ,
    Aliveinfo6-PDU [4] Aliveinfo6-PDU ,
    Inq-PDU [5] Inq-PDU ,
    Ninq-PDU [6] Ninq-PDU ,
    Reply-PDU [7] Reply-PDU ,
    RetransEnq-PDU [8] RetransEnq-PDU ,
    RetransConfirm-PDU [9] RetransConfirm-PDU ,
    RetransNak-PDU [10] RetransNak-PDU
}
```

FALAR-N Header to be used in each PDU is shown as follows.

```
FALAR-N Header ::= SEQUENCE {
    hd_h_type Hd_h_type ,
    hd_ml Hd_ml ,
    hd_sa Hd_sa ,
    hd_da Hd_da ,
    hd_v_seq Hd_v_seq ,
    hd_seq Hd_seq ,
    hd_m_ctl Hd_m_ctl ,
    hd_inqid Hd_inqid ,
    hd_tcd Hd_tcd ,
    hd_ver Hd_ver ,
    reserved1 OctString SIZE(3) ,
    hd_pkind Hd_pkind ,
    hd_pseq Hd_pseq ,
    hd_mode Hd_mode ,
    hd_pver Hd_pver ,
    hd_pri Hd_pri ,
    hd_cbn Hd_cbn ,
    hd_tbn Hd_tbn ,
    hd_bsize Hd_bsize ,
    reserved2 OctString SIZE(4)
}
```

```
Hd_inqid ::= SEQUENCE {
    inqid_inq_sa Inqid_inq_sa ,
    inqid_tr_adr Inqid_tr_adr ,
    inqid_id_seq Inqid_id_seq
}
```

4.2.2 CyclicData-PDU

```
CyclicData-PDU ::= SEQUENCE {
    falArHeader FALAR-N Header ,
    tmid Tmid ,
    blockNumber BlockNumber ,
    blockCount BlockCount ,
    cyclicData CyclicData
}
```

}

4.2.3 MulticastData-PDU

```
MulticastData-PDU ::= SEQUENCE {
    falArHeader          FALAR-N Header ,
    multicastData         MulticastData
}
```

4.2.4 PtoPData-PDU

```
PtoP Data-PDU ::= SEQUENCE {
    falArHeader          FALAR-N Header ,
    pointToPointDataPointToPointData
}
```

4.2.5 Aliveinfo-PDU

```
Aliveinfo-PDU ::= SEQUENCE {
    falArHeader          FALAR-N Header ,
    alive4Header         ALIVE4 Header ,
    al_ExtentionList     SEQUENCE of Al_ExtentionList ,
    al_ExtentionInfo    Al_ExtenyionInfo
}
```

```
ALIVE4 Header ::= SEQUENCE {
    al_nd_name           Al_nd_name ,
    al_os_name           Al_os_name ,
    al_tm_out            Al_tm_out ,
    al_msgserno         Al_msgserno ,
    al_mode             Al_mode ,
    al_protocol         Al_protocol ,
    al_tg_cmn_cnt       Al_tg_cmn_cnt ,
    al_tg_cflag         Al_tg_cflag ,
    reserved1           OctString SIZE(1) ,
    al_tg_max           Al_tg_max ,
    al_tg_usecmt       Al_tg_usecmt ,
    al_chg_time         Al_chg_time ,
    al_ipv4addr1        Al_ipv4addr1 ,
    al_ipv4addr2        Al_ipv4addr2 ,
    al_ver              AL_ver ,
    reserved2           OctString SIZE(15)
}
```

```
Al_ExtentionList ::= SEQUENCE {
    al_ta_chgalvstat Al_ta_chgalvstat ,
    al_ta_chginfostat Al_ta_chginfostat ,
    al_ta_tid        Al_ta_tid ,
    al_ta_data       Al_ta_data
}
```

4.2.6 Aliveinfo6-PDU

```
Aliveinfo6-PDU ::= SEQUENCE {
    falArHeader          FALAR-N Header,
    alive6Header         ALIVE6 Header ,
    al_ExtentionList     SEQUENCE of Al_ExtentionList ,
    al_ExtentionInfo    Al_ExtentionInfo
}
```

```
ALIVE6 Header ::= SEQUENCE {
```

al_nd_name	Al_nd_name ,
al_os_name	Al_os_name ,
al_tm_out	Al_tm_out ,
al_msgserno	Al_msgserno ,
al_mode	Al_mode ,
al_protocol	Al_protocol ,
al_tg_cmn_cnt	Al_tg_cmn_cnt ,
al_tg_cflag	Al_tg_cflag ,
reserved1	OctString SIZE(1) ,
al_tg_max	Al_tg_max ,
al_tg_usecmt	Al_tg_usecmt ,
al_chg_time	Al_chg_time ,
reserved2	Al_ipv4addr1 ,
reserved3	Al_ipv4addr2 ,
al_ver	Al_ver ,
reserved4	OctString SIZE(15) ,
al_ipv6addr1	Al_ipv6addr1 ,
al_ipv6addr2	Al_ipv6addr2
}	

4.2.7 Inq-PDU

Inq-PDU ::= SEQUENCE {	
falArHeader	FALAR-N Header ,
inquirydata	InquiryData
}	

4.2.8 Ninq-PDU

Ninq-PDU ::= SEQUENCE {	
falArHeader	FALAR-N Header ,
node-list	Node-List ,
ninqdata	NinqData
}	

4.2.9 Reply-PDU

Reply-PDU ::= SEQUENCE {	
falArHeader	FALAR-N Header
}	

4.2.10 RetransEnq-PDU

RetransEnq-PDU ::= SEQUENCE {	
falArHeader	FALAR-N Header ,
retransRequest	RetransRequest ,
retransRequestNode	RetransRequestNode ,
retransNumberOfRequests	RetransNumberOfRequests ,
reserved1	OctString SIZE(4) ,
retransInfo-List	SEQUENCE of RetransInfoList
}	

RetransInfoList ::= SEQUENCE {	
retransMcg	RetransMcg ,
retransPseqNo	RetransPseqNo
}	

4.2.11 RetransConfirm-PDU

RetransConfirm ::= SEQUENCE {	
falArHeader	FALAR-N Header ,
retransRequest	RetransRequest ,

retransNumberOfRequests	RetransNumberOfRequests ,
retransInfo-List	SEQUENCE of RetransInfoList
}	

4.2.12 RetransNak-PDU

RetransNAK-PDU::= SEQUENCE {	
f alArHeader	FALAR-N Header ,
retransRequest	RetransRequest ,
retransNumberOfRequests	RetransNumberOfRequests ,
retransInfo-List	SEQUENCE of RetransInfoList
}	

4.3 Data type assignments for type S

Data types used in FALPDU type S abstract syntax are shown as follows.

```

BLK_Status::= Unsigned32
BlockData::= OCTET STRING(SIZE=64)
BlockNum::= Unsigned16
CLASS::= Unsigned16
CLTData::= OCTET STRING(SIZE = 18..1472)
CYCLIC_FCS::= Unsigned32
EntryNum::= Unsigned32
ERR_ADD::= Unsigned32
HEADER_TYPE::= Unsigned16
INFOData::= OCTET STRING(SIZE = 18..1472)
IP_Header::= OCTET STRING(SIZE=20)
MODULE_ID::= Unsigned16
Node_Status::= Unsigned32
Pattern16::= Unsigned16
Pattern32::= Unsigned32
Pattern8::= Unsigned8
PLD::= Unsigned32
PortNum::= Unsigned32
Priority::= Unsigned8
RCL_Status::= Unsigned32
RCLCMD::= Unsigned32
RCLKIND::= Unsigned32
RMT_ADD::= Unsigned32
RMT_LENGTH::= Unsigned16
RMTCTL_CMD::= Unsigned16
RMTCTL_DATA::= OCTET STRING(SIZE = 0..1440)
RMTKIND::= Unsigned16
SendTime::= OCTET STRING(SIZE=8)
SequenceNum32::= Unsigned32
SND_NUM::= Unsigned16
ST_Address::= Unsigned8
ST_NUM::= Unsigned16
STATUS::= Unsigned32
TOTAL_BLOCK::= Unsigned8
UDP_Header::= OCTET STRING(SIZE=8)

```

4.4 Data type assignments for type N

Data types used in FALPDU type N abstract syntax are shown as follows.

```

Al_ExtentionInfo::= OctString SIZE(0..664)
Al_chg_time::= Unsigned32
Al_ipv4addr1::= OctString SIZE(4)

```

Al_ipv4addr2::= OctString SIZE(4)
Al_ipv6addr1::= OctString SIZE(16)
Al_ipv6addr2::= OctString SIZE(16)
Al_mode::= Unsigned8
Al_msgsernot::= Unsigned16
Al_nd_name::= OctString SIZE(10)
Al_os_name::= OctString SIZE(10)
Al_protocol::= Unsigned8
Al_ta_chgalvstat::= Unsigned8
Al_ta_chginfolstat::= Unsigned8
Al_ta_data::= integer16
Al_ta_tid::= Unsigned16
Al_tg_cflag::= Unsigned8
Al_tg_cmh_cnt::= Unsigned16
Al_tg_max::= Unsigned16
Al_tg_usecnt::= Unsigned16
Al_tm_out::= Unsigned32
AL_ver::= Unsigned8
BlockCount::= Unsigned16
BlockNumber::= Unsigned16
CyclicData::= Octstring SIZE(64..16640)
Data type assignment
Hd_bsize::= unsigned16
Hd_cbn::= unsigned8
Hd_da::= unsigned32
Hd_h_type::= unsigned32
Hd_m_ctl::= unsigned32
Hd_ml::= unsigned32
Hd_mode::= integer16
Hd_pkind::= unsigned8
Hd_pri::= unsigned8
Hd_pseq::= unsigned32
Hd_pver::= unsigned8
Hd_sa::= unsigned32
Hd_seq::= unsigned32
Hd_tbn::= unsigned8
Hd_tcd::= unsigned16
Hd_v_seq::= unsigned32
Hd_ver::= unsigned16
Inqid_id_seq::= unsigned32
Inqid_inq_sa::= unsigned32
Inqid_tr_adr::= unsigned32
InquiryData::= OctString SIZE(0..262144)
MulticastData::= OctString SIZE(0..262144)
Node-List::= OctString SIZE(512)
PointToPointData::= OctString SIZE(0..262144)
RetransMcg::= unsigned32
RetransNumberOfRequests::= unsigned32
RetransPseqNo::= unsigned32
RetransRequest::= unsigned32
RetransRequestNode::= unsigned32
Tmid::= Unsigned32

5 FAL transfer syntax

5.1 Encoding rules

5.1.1 Unsigned encoding

The fixed-length, unsigned values Unsigned8, Unsigned16, Unsigned24, and Unsigned32 are encoded as unsigned integers of one octet, two octets, three octets, and four octets in length, respectively. Unsigned16, Unsigned24, and Unsigned32 are encoded as big endians, where the most significant octet is regarded as the first octet, the next octet is regarded as the second octet, and the least significant octet is regarded as the last octet.

5.1.2 Octet string encoding

OctetString which has variable number of octets is encoded octet by octet, in sequential order.

5.1.3 SEQUENCE encoding

SEQUENCE encoding is performed in sequence, starting from the initial element. The identifiers and length used in ASN.1 are not used.

5.2 FALPDU type S elements encoding

5.2.1 RCL_header

5.2.1.1 Frame Class

This field shows the PDU classes described in Table 4.

Table 4 – Frame Class

Value	Description
0x0001	Class 1 frame (RHE-PDU)
0x0002	Class 2 frame (LCC-PDU, LCA-PDU, LCN-PDU, LNA-PDU, SCR-PDU)

5.2.1.2 Dst Address

5.2.1.2.1 Reserved1

This field is reserved for future use. This value is 0x00.

5.2.1.2.2 DA_STAddress

This field indicates the destination station address described in Table 5.

Table 5 – DA_STAddress – DA_STAddress

Value	Description
0xFF	RHE-PDU, LCC-PDU, LCN-PDU, SCR-PDU
SA_STAddress in the received LCC-PDU	LCA-PDU
SA_STAddress in the received LCN-PDU	LNA-PDU

5.2.1.2.3 DA_MACAddress

This field indicates the destination MAC address described in Table 6.

Table 6 – DA_MACAddress

Value	Description
FF-FF-FF-FF-FF-FF	RHE-PDU, LCC-PDU, LCN-PDU, SCR-PDU
SA_MACAddress in the received LCC-PDU	LCA-PDU
SA_MACAddress in the received LCN-PDU	LNA-PDU

5.2.1.3 Src Address

5.2.1.3.1 Reserved2

This field is reserved for future use. This value is 0x00.

5.2.1.3.2 SA_STAddress

This field indicates the station address of the own node.

5.2.1.3.3 SA_MACAddress

This field indicates the MAC address of the own node.

5.2.1.4 RCL Command

Table 7 shows RCL Command (CMD) field format. This field is used to identify the RCL frame. Each bit in this field has the following meanings:

Table 7 – CMD field format

Bit	Value						Description
	RHE	LCC	LCA	LCN	LNA	SCR	
[3:0]	1						reserved field1
[7:4]	0	0	1	2	3	0	unique number 1
[11:8]	0	1	1	1	1	3	unique number 2
[15:12]	0						reserved field2
[23:16]	1	2	2	2	2	2	indicates the frame class
[31:24]	0						reserved field3

5.2.1.5 Frame Sequence

The frame sequence number is used to detect loss and duplication of received frames. The range of this value is from 0x00000000 to 0xFFFFFFFF with step size 1.

5.2.1.6 Reserved3

This field is reserved for future use. The value is 0.

5.2.2 RHE-PDU

5.2.2.1 RHE_Common

5.2.2.1.1 Send Direction

This field contains the transmission port of the RHE-PDU as described in Table 8.

Table 8 – Send Direction

Value	Description
0x01	Port A
0x02	Port B

5.2.2.1.2 RHE Sequence

This field contains the identification number of the RHE-PDU. The range of this value is from 0x0000 to 0xFFFF. The same value is used in port A and port B.

5.2.2.2 Neighborhood address

5.2.2.2.1 Reserved1

This field is reserved for future use. The value is 0x00.

5.2.2.2.2 NB_STaddress

This field indicates the station address of the neighborhood node.

5.2.2.2.3 NB_MACaddress

This field indicates the MAC address of the neighborhood node.

5.2.2.3 RHE RecieveStatus

This field indicates the status about receiving RHE-PDU as described in Table 9.

Table 9 – RHE ReceiveStatus

Value	Description
1	Receiving RHE-PDU
0	Not receiving RHE-PDU

5.2.2.4 True Status

5.2.2.4.1 Reserved2

This field is reserved for future use. The value is 0x00000000.

5.2.2.4.2 Physical Linkdown

This field indicates the link status at the port as described in Table 10.

Table 10 – Physical Linkdown

Value	Description
1	Physical Link up
0	Physical Link down

5.2.2.4.3 Reserved3

This field is reserved for future use. The value is 0x00000000.

5.2.2.5 Blocking Status

This field indicates the status code about the port.

5.2.2.6 Node Status

This field indicates the status code about the node.

5.2.2.7 Reserved4

This field is reserved for future use. This value is 0.

5.2.2.8 Reserved5

This field is reserved for future use. This value is 0.

5.2.2.9 RHE_pattern1~4

This field is used to check the pattern of RHE-frames as described in Table 11. The patterns are repeated until the maximum length of ISO/IEC 8802-3 standard's frame.

Table 11 – RHE_pattern 1~4

Pattern	Octets	Value
RHE_pattern1	4	0xFFFFFFFF
RHE_pattern2	4	0xAAAAAAAA
RHE_pattern3	4	0x55555555
RHE_pattern4	4	0x00000000

5.2.3 LCC-PDU

5.2.3.1 LCC Kind

This field indicates the reason of sending LCC-PDU as described in Table 12.

Table 12 – LCC-Kind

Value	Description
0x00000101	Logical link up port A of the node
0x00000201	Competitive of receiving other LCC-PDU

5.2.3.2 LCC Priority

5.2.3.2.1 LCC_Priority

This field indicates the priority of LCC-PDU. This value is 0x0C.

5.2.3.2.2 LCC_STadd

This field indicates the station address of the own node.

5.2.3.2.3 LCC_MACadd

This field indicates the MAC address of the own node.

5.2.3.3 Reserved1

This field is reserved for future use. This value is 0.

5.2.4 LCA-PDU

5.2.4.1 Reserved1

This field is reserved for future use. This value is 0x01.

5.2.4.2 RCL Status

This field indicates the status of the node sending LCA-PDU as described in Table 13.

Table 13 – RCL Status

Field name	Bit	Value	Description
-	31 .. 24	0x00	Reserved
Node status	23	0 or 1	1: The node is in "Edge-A" state. When the bit 23 and 22 are "1", the node is in "Isolated" state. 0: The node is in other node status (Edge-B or Intermediate).
	22	0 or 1	1: The node is in "Edge-B" state. When the bit 23 and 22 are "1", the node is in "Isolated" state. 0: The node is in other node status (Edge-A or Intermediate).
-	21	0	Reserved
Blocking status	20	0 or 1	1: Port A or B is logical link down port.
-	19 .. 8	0x000	Reserved
Port status	7	0 or 1	1: Port A is in "Port_Linkup" state.
	6	0 or 1	1: Port B is in "Port_Linkup" state.
	5	0 or 1	1: Port A is physical link up.
	4	0 or 1	1: Port B is physical link up.
-	3 .. 0	0x0	Reserved

5.2.4.3 LCA Priority

5.2.4.3.1 LCA_Priority

This field indicates the priority in the received LCC-PDU.

5.2.4.3.2 LCA_STadd

This field indicates the station address in the received LCC-PDU.

5.2.4.3.3 LCA_MACadd

This field indicates the MAC address in the received LCC-PDU.

5.2.4.4 Reserved2

This field is reserved for future use. This value is 0.

5.2.5 LCN-PDU

5.2.5.1 Reserved1

This field is reserved for future use. This value is 0x01.

5.2.5.2 RCL Status

This field indicates the status of the node sending LCN-PDU. It has the same format as “5.2.4.2 RCL Status” described in Table 13.

5.2.5.3 Reserved2

This field is reserved for future use. This value is 0.

5.2.6 LNA-PDU

5.2.6.1 Reserved1

This field is padding area. This value is 0x00.

5.2.6.2 RCL Status

This field indicates the status of the node sending LNA-PDU. It has the same format as “5.2.4.2 RCL Status” described in Table 13.

5.2.6.3 Reserved2

This field is reserved for future use. This value is 0.

5.2.7 SCR-PDU

5.2.7.1 Entry Number

This field indicates the number to contain the SCR_Event entry.

5.2.7.2 SendStat Time

This field contains the sending time of seconds.

5.2.7.3 Reserved1

This field is reserved for future use. This value is 0.

5.2.7.4 Event0~16

This field contains the event information and specifies each manufacture.

5.2.8 Cyclic_S-PDU

5.2.8.1 IP_header

The encoding of the fields shall be according to RFC 791.

5.2.8.2 UDP_header

The encoding of the fields shall be according to RFC 768.