

DIN EN 61158-5-23

ICS 35.100.70; 35.160

**Industrielle Kommunikationsnetze –
Feldbusse –
Teil 5-23: Dienstfestlegungen des Application Layer
(Anwendungsschicht) – Typ 23-Elemente
(IEC 61158-5-23:2014);
Englische Fassung EN 61158-5-23:2014, nur auf CD-ROM**

Industrial communication networks –
Fieldbus specifications –
Part 5-23: Application layer service definition – Type 23 elements
(IEC 61158-5-23:2014);
English version EN 61158-5-23:2014, only on CD-ROM

Réseaux de communication industriels –
Spécifications des bus de terrain –
Partie 5-23: Définition des services de la couche application – Éléments de type 23
(CEI 61158-5-23:2014);
Version anglaise EN 61158-5-23:2014, seulement en CD-ROM

Gesamtumfang 99 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

Anwendungsbeginn

Anwendungsbeginn für die von CENELEC am 2014-09-22 angenommene Europäische Norm als DIN-Norm ist 2015-08-01.

Nationales Vorwort

Vorausgegangener Norm-Entwurf: E DIN EN 61158-500:2013-08.

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.

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

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

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

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

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

Der Zusammenhang der zitierten Normen mit den entsprechenden Deutschen Normen ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als 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 61158-5-23 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt, und Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als Nationaler Anhang NA der vorliegenden Norm hinzugefügt. Für viele 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.

Einführung

Ein Feldbus ist ein digitaler serieller Datenbus für die Kommunikation zwischen Geräten der industriellen Automatisierungstechnik wie beispielsweise Messeinrichtungen, Stellgliedern, Reglern und speicherprogrammierbaren Steuerungen. Die Normen der Reihe DIN EN 61158 legen eine Anzahl von Feldbus-Protokolltypen fest. Die vorliegende Norm legt die Dienste des Application Layer für Typ 23 fest.

Nationaler Anhang NA

(informativ)

1 Anwendungsbereich^{N1)}

1.1 Allgemeines

Der Feldbus-Application Layer (FAL) liefert Benutzerprogramme mit Hilfsmitteln für den Zugriff auf die Feldbuskommunikationsumgebung. In dieser Hinsicht kann der FAL als ein Fenster zwischen zugehörigen Anwendungsprogrammen betrachtet werden.

Diese Norm stellt für Typ 23-Feldbusse maßgebliche allgemeine Elemente für zeitkritischen und nicht zeitkritischen Datentransfer zwischen Anwendungsprogrammen in einer Automatisierungsumgebung bereit. Der Begriff „zeitkritisch“ (en: time-critical) wird verwendet, um die Präsenz eines Zeitfensters darzustellen, in dem eine oder mehrere festgelegte Aktivitäten mit einem vorbestimmten Grad an Gewissheit erledigt werden. Das Scheitern der Erledigung der festgelegten Aktivität innerhalb des Zeitfensters trägt das Risiko des Betriebsausfalls der Anwendung mit und somit das aufgeförderte Eingreifen mit dazugehörigem Risiko für Geräte, Anlage und möglicherweise Menschenleben.

Diese Norm definiert auf eine abstrakte Art und Weise den von außen sichtbaren Dienst, der vom Typ 23 des Feldbus-Application Layer bereitgestellt wird, in Form von:

- a) einem abstrakten Modell für das Beschreiben von Anwendungsressourcen (Objekten), die von Benutzern mittels FAL-Diensten verstellt werden können,
- b) Aktivitäten und Ereignissen der Dienstprimitiven,
- c) den mit den Aktivitäten und Ereignissen der Dienstprimitiven verbundenen Parametern, sowie der Form, die sie einnehmen und
- d) dem Zusammenhang zwischen diesen Aktivitäten und Ereignissen und ihren gültigen Abläufen.

Die Zielsetzung dieser Norm ist es, Dienste zu definieren, die bereitgestellt werden für:

- den FAL-Benutzer an der Grenze zwischen dem Benutzer und dem Application Layer des Feldbus-Referenzmodells und
- das Systemmanagement an der Grenze zwischen dem Application Layer und dem Systemmanagement des Feldbus-Referenzmodells.

Diese Norm beschreibt die Struktur und die Dienste des Typ 23-Feldbus-Application Layer in Übereinstimmung mit dem OSI-Basis-Referenzmodell (ISO/IEC 7498-1) und der OSI-Application Layer-Struktur (ISO/IEC 9545).

FAL-Dienste und Protokolle sind von FAL-Anwendungseinheiten (AE) bereitgestellt, welche innerhalb von Anwendungsprozessen enthalten sind. Die FAL AE besteht aus einer Menge von objektorientierten Anwendungsdienstelementen (ASEs) und Layer-Management-Einheiten (LME), welche die AE verwalten. Die ASEs liefern Kommunikationsdienste, die auf einer Menge von zugehörigen Anwendungsprozessobjekt(APO-) Klassen arbeitet. Eine der FAL ASEs ist eine Management-ASE, welche eine Menge gemeinsamer Dienste für das Management der Instanzen der 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 anfragenden und antwortenden Anwendungen mit diesen vorzunehmen haben. Die Verhaltensaspekte der Anwendungen sind nicht festgelegt, nur eine Definition, welche 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 unterstützende Dienste festgelegt, um den Zugriff zum FAL bereitzustellen und somit bestimmte Aspekte des Betriebs zu steuern.

^{N1)} Die Nummerierung aus IEC 61158-5-23 wurde beibehalten.

1.2 Spezifikationen

Das hauptsächliche Ziel dieser Norm ist es, für zeitkritische Kommunikation geeignete Eigenschaften der konzeptionellen Application Layer-Dienste festzulegen und folglich die Ergänzung des OSI-Basisreferenzmodells mit der Anleitung der Entwicklung der Application Layer-Protokolle für die zeitkritische Kommunikation.

Ein zweites Ziel ist das Bereitstellen von Migrationspfaden von bisherigen bestehenden industriellen Kommunikationsprotokollen. Es ist dieses letztere Ziel, welches zur Steigerung von unterschiedlichen genormten Diensten, als verschiedene Typen der IEC 61158, führt.

Diese Spezifikation darf als Basis für formelle Application-Programmierschnittstellen verwendet werden. Nichtsdestotrotz ist es keine formelle Programmierschnittstelle, und jede derartige Schnittstelle hat Implementierungsanforderungen zu erfüllen, die nicht von dieser Spezifikation abgedeckt werden und Folgendes beinhalten:

- a) die Größen und Oktett-Folgen von verschiedenen Multi-oktett-Dienstparametern,
- b) die Korrelation von gepaarten Anfrage- und Indikationsprimitiven oder Anweisungs- und Antwortprimitiven.

1.3 Konformität

Diese Norm legt keine individuellen Implementierungen oder Produkte fest, auch beschränkt sie die Implementierungen von Application Layer-Einheiten innerhalb eines industriellen Automatisierungssystems nicht.

Es gibt keine Konformität von Geräten zu dieser Application Layer-Dienstdefinitionsnorm. Stattdessen wird Konformität durch die Implementierung der entsprechenden Application Layer-Protokolle erreicht, welche den Typ 23 der Application Layer-Dienste, wie in dieser Norm beschrieben, erfüllen.

3.2 Spezielle Begriffe für den Feldbus-Application Layer Typ 23

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

3.2.1

zyklische Übertragung

(en: cyclic transmission)

periodisch durchgeführte Übertragung zur Aktualisierung des Link-Gerätes

3.2.2

intelligente Gerätestation

(en: intelligent device station)

Knoten, der die zyklische und transiente Übertragung von 1:n-Bitdaten und -Wortdaten mit der Master-Station sowie die transiente Übertragung mit Slave-Stationen, außer entfernten E/A-Stationen, ausführen kann und während der transienten Übertragung über Client- und Server-Funktionen verfügt

3.2.3

Link-Bit

(en: link bit)

auf dem Verbindungszweig weitergegebene Bitdaten, die von allen Knoten bei der zyklischen Übertragung gemeinsam genutzt werden; wird als ein in Biteinheiten organisierter gemeinsamer Speicher des n:n-Typs genutzt

3.2.4

Link-Gerät

(en: link device)

Link-Bit, Link-Wort, Link x und Link y oder RX, RY, RWr und RWw

3.2.5**Link-Wort**

(en: link word)

Daten in der Einheit von zwei Oktetten des Verbindungszweig-Registers, die von allen Knoten bei der zyklischen Übertragung gemeinsam genutzt werden; wird als ein in der Einheit von zwei Oktetten organisierter gemeinsamer Speicher des n:n-Typs genutzt

3.2.6**Link x**

(en: link x)

auf dem Verbindungszweig empfangene Bit-Eingangsdaten, die von jedem Knoten bei der zyklischen Übertragung übermittelt werden; wird als gemeinsamer Eingangsspeicher für den 1:n-Typ verwendet

3.2.7**Link y**

(en: link y)

Bit-Ausgangsdaten auf dem Verbindungszweig, die bei der zyklischen Übertragung an jeden Knoten gesendet werden; wird als gemeinsamer Ausgangsspeicher für den 1:n-Typ verwendet

3.2.8**lokale Station**

(en: local station)

Knoten, der die zyklische und transiente Übertragung von n:n-Bitdaten und -Wortdaten mit der Master-Station und anderen lokalen Stationen sowie die transiente Übertragung mit Slave-Stationen, außer entfernten E/A-Stationen, ausführen kann und während der transienten Übertragung über Server- und Client-Funktionen verfügt

3.2.9**Steuerungsknoten**

(en: management node)

Knoten, in dem Parameter festgelegt werden

3.2.10**Master-Station**

(en: master station)

Knoten, der über Steuerungsinformationen (Parameter) verfügt und die zyklische Übertragung regelt

3.2.11**Knoten**

(en: node)

Element, das ein Netzwerk bildet und die Datenübertragung, den Empfang und den Transfer ausführt

3.2.12**Knoten-zu-Knoten-Prüfung**

(en: node-to-node test)

Prüfung zwischen zwei Knoten auf dem Physical Layer

3.2.13**normaler Knoten**

(en: normal node)

anderer Knoten als ein Steuerungsknoten

3.2.14**entfernte Gerätestation**

(en: remote device station)

Knoten, der die zyklische und transiente Übertragung von 1:n-Bitdaten und -Wortdaten mit der Master-Station sowie die transiente Übertragung mit Slave-Stationen, außer entfernten E/A-Stationen, ausführen kann und während der transienten Übertragung über Server-Funktionen verfügt

3.2.15**entfernte E/A-Station**

(en: remote I/O station)

Knoten, der die zyklische und transiente Übertragung von 1:n-Bitdaten mit der Master-Station ausführen kann

3.2.16

reservierter Knoten

(en: reserve node)

Knoten, der noch nicht verbunden ist, aber in der Gesamtknotenzahl des Netzwerks enthalten ist, und der keine zyklische Übertragung ausführt, aber von Anwendungen als normaler Knoten betrachtet wird

3.2.17

RX

(en: RX)

entferntes Register (Eingabe), aus der Sicht der Master-Station, mit Bitdaten, die durch die zyklische Übertragung periodisch aktualisiert werden, vom Slave zum Master, oder in einer lokalen Station, aus der Sicht der Master-Station, die RY der lokalen Station ist

3.2.18

RY

(en: RY)

entferntes Register (Ausgang) aus der Sicht der Master-Station mit Bitdaten, die durch zyklische Übertragung periodisch aktualisiert werden, vom Master zum Slave, oder in einer lokalen Station, aus der Sicht der Master-Station, die RX der lokalen Station ist

3.2.19

RWr

(en: RWr)

entferntes Register (Eingabe), aus der Sicht der Master-Station, mit Wortdaten, die durch zyklische Übertragung periodisch aktualisiert werden, vom Slave zum Master, oder in einer lokalen Station, aus der Sicht der Master-Station, die RWw der lokalen Station ist

3.2.20

RWw

(en: RWw)

entferntes Register (Ausgang), aus der Sicht der Master-Station, mit Wortdaten, die durch zyklische Übertragung periodisch aktualisiert werden, vom Master zum Slave, oder in einer lokalen Station, aus der Sicht der Master-Station, die RWr der lokalen Station ist

3.2.21

Slave-Station

(en: slave station)

anderer Knoten als die Master-Station

3.2.22

Station

(en: station)

Knoten

3.2.23

Synchronisationsmanager

(en: synchronization manager)

Knoten (Rolle der Master-Station, die je Netzwerk einmal vorhanden ist), der die Synchronisation steuert und die Synchronisationssteuerung an andere Knoten verteilt

3.2.24

transiente Übertragung

(en: transient transmission)

Übertragung, die auf jede Anforderung hin ausgeführt wird

3.2.25

Client-Funktion bei der transienten Übertragung

(en: transient transmission client function)

Funktion, die eine transiente Anforderung ausgibt

3.2.26

Server-Funktion bei der transienten Übertragung

(en: transient transmission server function)

Funktion, die eine transiente Anforderung empfängt und eine Antwort ausgibt

3.2.27

Übertragungssteuerungsmanager

(transmission control manager)

Knoten (Rolle der Master-Station, die je Netzwerk einmal vorhanden ist), der die Tokenweitergabe steuert

3.2.28

Wort

(en: word)

Einheit, die Daten repräsentiert und 16 Bit lang ist

– Leerseite –

ICS 25.040.40; 35.100.70; 35.110

English Version

**Industrial communication networks - Fieldbus specifications -
Part 5-23: Application layer service definition - Type 23 elements
(IEC 61158-5-23:2014)**

Réseaux de communication industriels - Spécifications des
bus de terrain - Partie 5-23: Définition des services de la
couche application - Éléments de type 23
(CEI 61158-5-23:2014)

Industrielle Kommunikationsnetze - Feldbusse -
Teil 5-23: Dienstfestlegungen des Application Layer
(Anwendungsschicht) - Typ 23-Elemente
(IEC 61158-5-23:2014)

This European Standard was approved by CENELEC on 2014-09-22. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 65C/763/FDIS, future edition 1 of IEC 61158-5-23, 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 61158-5-23:2014.

The following dates are fixed:

- latest date by which the document has to be (dop) 2015-06-22
implemented at national level by
publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2017-09-22
standards conflicting with the
document have to be withdrawn

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

Endorsement notice

The text of the International Standard IEC 61158-5-23:2014 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61784-1	NOTE	Harmonized as EN 61784-1.
IEC 61784-2	NOTE	Harmonized as EN 61784-2.

CONTENTS

INTRODUCTION.....	5
1 Scope	6
1.1 General.....	6
1.2 Specifications	7
1.3 Conformance	7
2 Normative references	7
3 Terms, definitions, symbols, abbreviated terms and conventions	8
3.1 Referenced terms and definitions	8
3.2 Type 23 specific terms and definitions.....	9
3.3 Symbols and abbreviated terms	11
3.4 Conventions	12
4 Concept	15
5 Data type ASE.....	15
5.1 Overview	15
5.2 Fixed length types	15
6 Communication model specification	20
6.1 Communication model	20
6.2 ASE	22
6.3 AR type C.....	57
6.4 AR type F	71
Bibliography	90
Annex ZA (normative) Normative references to international publications with their corresponding European publications.....	91
Figure 1 – Cyclic model (n:n type distributed shared memory, unconfirmed push model)	21
Figure 2 – Cyclic model (1:n type distributed shared memory, unconfirmed push model)	21
Figure 3 – Transient model (Client server model).....	21
Figure 4 – Transient model (Push model)	22
Figure 5 – Structure of ASE type C of FAL type 23	22
Figure 6 – Structure of ASE type F of FAL type 23.....	22
Figure 7 – Structure of AR type C.....	58
Figure 8 – Structure of AR type F	71
Table 1 – Ld service parameters	24
Table 2 – Set service parameters	24
Table 3 – Reset service parameters	24
Table 4 – Read service parameters	25
Table 5 – Write service parameters	25
Table 6 – Ld service parameters	26
Table 7 – Set service parameters	27
Table 8 – Reset service parameters	27
Table 9 – Read service parameters	28
Table 10 – Write service parameters	28

Table 11 – Ld service parameters	30
Table 12 – Set service parameters	31
Table 13 – Reset service parameters	31
Table 14 – Read service parameters	31
Table 15 – Write service parameters	32
Table 16 – Get memory access info service parameters	35
Table 17 – Run service parameters	36
Table 18 – Stop service parameters	36
Table 19 – Read memory service parameters	37
Table 20 – Write memory service parameters	38
Table 21 – Get memory access info service parameters	40
Table 22 – Run service parameters	41
Table 23 – Stop service parameters	42
Table 24 – Read memory service parameters	43
Table 25 – Write memory service parameters	44
Table 26 – Vendor command service parameters	45
Table 27 – Distribute node info service parameters	46
Table 28 – Get statistics service parameters	47
Table 29 – Get node info detail service parameters	49
Table 30 – AC data service parameters	51
Table 31 – AC data ND service parameters	52
Table 32 – Get attribute service parameters	53
Table 33 – Set attribute service parameters	54
Table 34 – Synchronization trigger service parameters	55
Table 35 – Start measurement service parameters	56
Table 36 – Get offset service parameters	57
Table 37 – Control cyclic service parameters	62
Table 38 – CT Update service parameters	63
Table 39 – AC Send service parameters	64
Table 40 – AC Param send service parameters	66
Table 41 – CPD Set service parameters	71
Table 42 – Control cyclic service parameters	78
Table 43 – CT Update service parameters	80
Table 44 – AC Send service parameters	81
Table 45 – AC Send ND service parameters	82
Table 46 – Synchronous trigger internal service parameters	87
Table 47 – Measure send service parameters	88
Table 48 – MeasureAck send service parameters	88
Table 49 – Offset send service parameters	89
Table 50 – Update send service parameters	89

INTRODUCTION

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

The application service is provided by the application protocol making use of the services available from the data-link or other immediately lower layer. This standard defines the application service characteristics that fieldbus applications and/or system management may exploit.

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

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 5-23: Application layer service definition – Type 23 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 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 12 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 standard defines in an abstract way the externally visible service provided by the different Types of the fieldbus Application Layer in terms of

- a) an abstract model for defining application resources (objects) capable of being manipulated by users via the use of the FAL service,
- b) the primitive actions and events of the service;
- c) the parameters associated with each primitive action and event, and the form which they take; and
- d) the interrelationship between these actions and events, and their valid sequences.

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

- a) the FAL user at the boundary between the user and the Application Layer of the Fieldbus Reference Model, and
- b) Systems Management at the boundary between the Application Layer and Systems Management of the Fieldbus Reference Model.

This standard specifies the structure and services 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 standard to provide access to the FAL to control certain aspects of its operation.

1.2 Specifications

The principal objective of this standard is to specify the characteristics of conceptual application layer services suitable for time-critical communications, and thus supplement the OSI Basic Reference Model in guiding the development of application layer protocols for time-critical communications.

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 services standardized as the various Types of IEC 61158, and the corresponding protocols standardized in subparts of IEC 61158-6.

This specification may be used as the basis for formal Application Programming-Interfaces. Nevertheless, it is not a formal programming interface, and any such interface will need to address implementation issues not covered by this specification, including

- a) the sizes and octet ordering of various multi-octet service parameters, and
- b) the correlation of paired request and confirm, or indication and response, primitives.

1.3 Conformance

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

There is no conformance of equipment to this application layer service definition standard. Instead, conformance is achieved through implementation of conforming application layer protocols that fulfill any given Type of application layer services as defined in this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 61158-1:2014, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-6 (all parts), *Industrial communication networks – Fieldbus specifications – Part 6: Application layer protocol specification*

ISO/IEC 646, *Information technology – ISO 7-bit coded character set for information interchange*

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

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

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

3 Terms, definitions, symbols, abbreviated terms and conventions

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

3.1 Referenced 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:

- a) application entity
- b) application process
- c) application protocol data unit
- d) application service element
- e) application entity invocation
- f) application process invocation
- g) application transaction
- h) real open system
- i) 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
- b) 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
- b) application-context
- c) application context name
- d) application-entity-invocation
- e) application-entity-type
- f) application-process-invocation
- g) application-process-type
- h) application-service-element
- i) 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
- b) type

3.1.5 IEC 61158-1 terms

For the purposes of this document, the following terms given in IEC 61158-1 apply:

- a) DLL mapping protocol machine
- b) fieldbus application layer
- c) FAL service protocol machine
- d) protocol data unit

3.2 Type 23 specific terms and definitions

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

3.2.1

cyclic transmission

transmission that is performed periodically used for the link device update

3.2.2

intelligent device station

node capable of performing 1:n bit data and word data cyclic transmission and transient transmission with the master station, and transient transmission with slave stations, excluding remote I/O stations and having client functions and server functions during transient transmission

3.2.3

link bit

link relay bit data that are shared by all the nodes through the cyclic transmission and is used as one bit unit shared memory of the n:n type

3.2.4

link device

link bit, link word, link x and link y or RX, RY, RWr, and RWw

3.2.5

link word

link register two octet unit data that are shared by all the nodes through the cyclic transmission and is used as two octet unit shared memory of the n:n type

3.2.6

link x

link input received bit data that are transmitted from each node through the cyclic transmission and is used as an input shared memory of the 1:n type

3.2.7

link y

link output bit data that are sent to each node through the cyclic transmission and is used as an output shared memory of the 1:n type

3.2.8

local station

node capable of performing n:n bit data and word data cyclic transmission and transient transmission with the master station and other local stations, and transient transmission with slave stations, excluding remote I/O stations and having server functions and client functions during transient transmission

3.2.9

management node

node in which parameters are set

3.2.10

master station

node that has control information (parameters) and manages cyclic transmission

3.2.11

node

element that forms a network and performs data transmission, reception, and transfer

3.2.12

node-to-node test

physical layer test between two nodes

3.2.13

normal node

node other than a management node

3.2.14

remote device station

node capable of performing 1:n bit data and word data cyclic transmission and transient transmission with the master station, and transient transmission with slave stations, excluding remote I/O stations and having server functions during transient transmission

3.2.15

remote I/O station

node capable of performing 1:n bit data cyclic transmission with the master station

3.2.16

reserve node

node that is not yet connected, but counted in the total node number of the network not performing cyclic transmission, but always regarded as normal from applications

3.2.17

RX

remote input as viewed from the master station with bit data that are periodically updated by cyclic transmission, slave to master, or in local station as viewed from the master station is RY of the local station

3.2.18

RY

remote output as viewed from the master station with bit data that are periodically updated by cyclic transmission, master to slave, or in local station as viewed from the master station is RX of the local station

3.2.19

RWr

remote register (input) as viewed from the master station with word data that are periodically updated by cyclic transmission, slave to master, or in local station as viewed from the master station is RWW of the local station

3.2.20

RWw

remote register (output) as viewed from the master station with word data that are periodically updated by cyclic transmission, master to slave, or in local station as viewed from the master station is RWr of the local station

3.2.21

slave station

node other than the master station

3.2.22

station

node

3.2.23

synchronization manager

node (master station role with one existing per network) that manages synchronization, distributing synchronization timing to other nodes

3.2.24

transient transmission

transmission that is performed upon each request

3.2.25

transient transmission client function

function that issues a transient request

3.2.26

transient transmission server function

function that receives a transient request and issues a response

3.2.27

transmission control manager

node (master station role with one existing per network) that performs token passing management

3.2.28

word

unit representing data, 16 bits in length

3.3 Symbols and abbreviated terms

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
ASE	Application Service Element
ASN.1	Abstract Syntax Notation 1
CRC	Cyclic Redundancy Check
DLL	Data-link Layer
DMPM	DLL Mapping Protocol Machine
FAL	Fieldbus Application Layer

FSPM	FAL Service Protocol Machine
LB	Link Bit
LSB	Least Significant Bit
LW	Link Word
LX	Link X
LY	Link Y
MSB	Most Significant Bit
OSI	Open Systems Interconnection
PDU	Protocol Data Unit

3.4 Conventions

3.4.1 General conventions

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

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

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

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

- the request primitive's input parameters;
- the indication primitive's output parameters;
- the response primitive's input parameters; and
- the confirm primitive's output parameters.

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

One parameter (or part of it) is listed in each row of each table. Under the appropriate service primitive columns, a code is used to specify the type of usage of the parameter on the primitive and parameter direction specified in the column:

- M** parameter is mandatory for the primitive.
- U** parameter is a User option, and may or may not be provided depending on the dynamic usage of the service-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 service-user.
- (blank) parameter is never present.

Some entries are further qualified by items in brackets. These may be a parameter-specific constraint:

- (=) indicates that the parameter is semantically equivalent to the parameter in the service primitive to its immediate left in the table.

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

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

3.4.2 Conventions for class definitions

Class definitions are defined using templates. Each template consists of a list of attributes and services for the class. The general form of the template is shown below:

FAL ASE:		ASE Name
CLASS:		Class Name
CLASS ID:		#
PARENT CLASS:		Parent Class Name
ATTRIBUTES:		
1	(o)	Key Attribute: numeric identifier
2	(o)	Key Attribute: name
3	(m)	Attribute: attribute name (values)
4	(m)	Attribute: attribute name (values)
4.1	(s)	Attribute: attribute name (values)
4.2	(s)	Attribute: attribute name (values)
4.3	(s)	Attribute: attribute name (values)
5	(c)	Constraint: constraint expression
5.1	(m)	Attribute: attribute name (values)
5.2	(o)	Attribute: attribute name (values)
6	(m)	Attribute: attribute name (values)
6.1	(s)	Attribute: attribute name (values)
6.2	(s)	Attribute: attribute name (values)
SERVICES:		
1	(o)	OpsService: service name
2	(c)	Constraint: constraint expression
2.1	(o)	OpsService: service name
3	(m)	MgtService: service name

- The "FAL ASE:" entry is the name of the FAL ASE that provides the services for the class being specified.
- The "CLASS:" entry is the name of the class being specified. All objects defined using this template will be an instance of this class. The class may be specified by this standard, or by a user of this standard.
- The "CLASS ID:" entry is a number that identifies the class being specified. This number is unique within the FAL ASE that will provide the services for this class. When qualified by the identity of its FAL ASE, it unambiguously identifies the class within the scope of the FAL. The value "NULL" indicates that the class cannot be instantiated. Class IDs between 1 and 255 are reserved by this standard to identify standardized classes. They have been assigned to maintain compatibility with existing national standards. CLASS IDs between 256 and 2048 are allocated for identifying user defined classes.
- The "PARENT CLASS:" entry is the name of the parent class for the class being specified. All attributes defined for the parent class and inherited by it are inherited for the class being defined, and therefore do not have to be redefined in the template for this class.

NOTE The parent-class "TOP" indicates that the class being defined is an initial class definition. The parent class TOP is used as a starting point from which all other classes are defined. The use of TOP is reserved for classes defined by this standard.

- e) The "ATTRIBUTES" label indicate that the following entries are attributes defined for the class.
- 1) Each of the attribute entries contains a line number in column 1, a mandatory (m) / optional (o) / conditional (c) / selector (s) indicator in column 2, an attribute type label in column 3, a name or a conditional expression in column 4, and optionally a list of enumerated values in column 5. In the column following the list of values, the default value for the attribute may be specified.
 - 2) Objects are normally identified by a numeric identifier or by an object name, or by both. In the class templates, these key attributes are defined under the key attribute.
 - 3) The line number defines the sequence and the level of nesting of the line. Each nesting level is identified by period. Nesting is used to specify
 - i) fields of a structured attribute (4.1, 4.2, 4.3),
 - ii) attributes conditional on a constraint statement (5). Attributes may be mandatory (5.1) or optional (5.2) if the constraint is true. Not all optional attributes require constraint statements as does the attribute defined in (5.2),
 - iii) the selection fields of a choice type attribute (6.1 and 6.2).
- f) The "SERVICES" label indicates that the following entries are services defined for the class.
- 1) An (m) in column 2 indicates that the service is mandatory for the class, while an (o) indicates that it is optional. A (c) in this column indicates that the service is conditional. When all services defined for a class are defined as optional, at least one has to be selected when an instance of the class is defined.
 - 2) The label "OpsService" designates an operational service (1).
 - 3) The label "MgtService" designates a management service (2).
 - 4) The line number defines the sequence and the level of nesting of the line. Each nesting level is identified by a period. Nesting within the list of services is used to specify services conditional on a constraint statement.

3.4.3 Conventions for service definitions

3.4.3.1 General

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

3.4.3.2 Service parameters

Service primitives are used to represent service user/service provider interactions (ISO/IEC 10731). They convey parameters which indicate information available in the user/provider interaction. In any particular interface, not all parameters need be explicitly stated.

The service specifications of this standard use a tabular format to describe the component parameters of the ASE service primitives. The parameters which apply to each group of service primitives are set out in tables. Each table consists of up to five columns for the

- a) parameter name,
- b) request primitive, (transmitted from the sender)
- c) indication primitive, (transmitted to the receiver)
- d) response primitive, (transmitted from the receiver) and
- e) confirm primitive (transmitted to the sender).

One parameter (or component of it) is listed in each row of each table. Under the appropriate service primitive columns, a code is used to specify the type of usage of the parameter on the primitive 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 dynamic usage of the service 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 service user.
- (blank) parameter is never present.
- S parameter is a selected item.

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

- 1) 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.
- 2) 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.

3.4.3.3 Service procedures

The procedures are defined in terms of:

- the interactions between application entities through the exchange of fieldbus Application Protocol Data Units, and
- the interactions between an application layer service provider and an application layer service user in the same system through the invocation of application layer service primitives.

These procedures are applicable to instances of communication between systems which support time-constrained communications services within the fieldbus application layer.

4 Concept

The basic concept of application layer services follows IEC 61158-1, Clause 9.

The FAL defined herein has two primary deployment models. A peer-level connection based controller network is identified throughout this FAL as type C. A master/slave oriented field network is identified throughout this FAL as type F. Both support a distributed memory model as well as client/server models.

5 Data type ASE

5.1 Overview

The overview of the data type ASE follows of IEC 61158-1, Clause 10. The template is used to define the data type for the FAL.

5.2 Fixed length types

5.2.1 Bitstring types

5.2.1.1 BitString8

FAL ASE:

Data type ASE

CLASS:

Data type

CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 22
2 Data type name	= Bitstring8
3 Format	= Fixed length
4.1 Octet length	= 1

5.2.1.2 BitString16

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 23
2 Data type name	= Bitstring16
3 Format	= Fixed length
4.1 Octet length	= 2

5.2.1.3 BitString32

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 24
2 Data type name	= Bitstring32
3 Format	= Fixed length
4.1 Octet length	= 4

5.2.2 Numeric types

5.2.2.1 Integer types

5.2.2.1.1 Integer8

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 2
2 Data type name	= Integer8
3 Format	= Fixed length
4.1 Octet length	= 1

This integer type is a two's complement binary number with a length of one octet.

5.2.2.1.2 Integer16

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 3
2 Data type name	= Integer16
3 Format	= Fixed length
4.1 Octet length	= 2

This integer type is a two's complement binary number with a length of two octets.

5.2.2.1.3 Integer32

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 4
2 Data type name	= Integer32
3 Format	= Fixed length
4.1 Octet length	= 4

This integer type is a two's complement binary number with a length of four octets.

5.2.2.2 Unsigned types

5.2.2.2.1 Unsigned8

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 5
2 Data type name	= Unsigned8
3 Format	= Fixed length
4.1 Octet length	= 1

This type is a binary number with a length of one octet. No sign bit is included. The most significant bit of the most significant octet is always used as the most significant bit of the binary number.

5.2.2.2.2 Unsigned16

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top

ATTRIBUTES:

1	Data type numeric identifier	=	6
2	Data type name	=	Unsigned16
3	Format	=	Fixed length
4.1	Octet length	=	2

This type is a binary number with a length of two octets. No sign bit is included. The most significant bit of the most significant octet is always used as the most significant bit of the binary number.

5.2.2.2.3 Unsigned32

FAL ASE:

Data type ASE

CLASS:

Data type

CLASS ID:

5

PARENT CLASS:

Top

ATTRIBUTES:

1	Data type numeric identifier	=	7
2	Data type name	=	Unsigned32
3	Format	=	Fixed length
4.1	Octet length	=	4

This type is a binary number with a length of four octets. No sign bit is included. The most significant bit of the most significant octet is always used as the most significant bit of the binary number.

5.2.2.3 OctetString character types

5.2.2.3.1 OctetString1

FAL ASE:

Data type ASE

CLASS:

Data type

CLASS ID:

5

PARENT CLASS:

Top

ATTRIBUTES:

1	Data type numeric identifier	=	30
2	Data type name	=	OctetString1
3	Format	=	Fixed length
4.1	Octet length	=	1

This type is an OctetString with a length of one octet.

5.2.2.3.2 OctetString2

FAL ASE:

Data type ASE

CLASS:

Data type

CLASS ID:

5

PARENT CLASS:

Top

ATTRIBUTES:

1	Data type numeric identifier	=	31
2	Data type name	=	OctetString2
3	Format	=	Fixed length
4.1	Octet length	=	2

This type is an OctetString with a length of two octets.

5.2.2.3.3 OctetString4

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 32
2 Data type name	= OctetString4
3 Format	= Fixed length
4.1 Octet length	= 4

This type is an OctetString with a length of four octets.

5.2.2.3.4 OctetString8

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 33
2 Data type name	= OctetString8
3 Format	= Fixed length
4.1 Octet length	= 8

This type is an OctetString with a length of eight octets.

5.2.2.3.5 OctetString16

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 34
2 Data type name	= OctetString16
3 Format	= Fixed length
4.1 Octet length	= 16

This type is an OctetString with a length of 16 octets.

5.2.2.3.6 MACAddress

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= -
2 Data type name	= MACAddress
3 Format	= Fixed length
4.1 Octet length	= 6

This type is an OctetString with a length of 6 octets and represents a MAC address.

5.2.2.4 Character String Type

5.2.2.4.1 OctetString

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 10
2 Data type name	= OctetString
3 Format	= string
4.1 Octet length	= 1 to n

This type is with a length of one to n octets. Octet 1 is referred to as the first octet.

5.2.2.4.2 VisibleString

FAL ASE:	Data type ASE
CLASS:	Data type
CLASS ID:	5
PARENT CLASS:	Top
ATTRIBUTES:	
1 Data type numeric identifier	= 9
2 Data type name	= VisibleString
3 Format	= string
4.1 Octet length	= 1 to n

This type is defined as the ISO/IEC 646 string type.

6 Communication model specification

6.1 Communication model

6.1.1 General

Two types of communication models are used in FAL type 23: The cyclic model and the transient model.

6.1.2 Cyclic model n:n

The n:n type distributed shared memory cyclic model is shown in Figure 1 and uses an unconfirmed push model performed periodically.

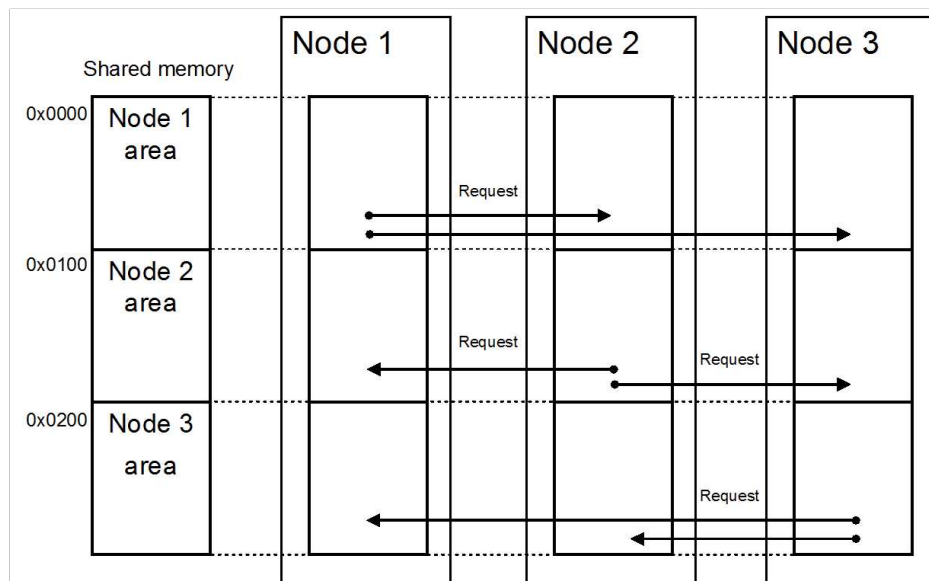


Figure 1 – Cyclic model (n:n type distributed shared memory, unconfirmed push model)

6.1.3 Cyclic model 1:n

The 1:n type distributed shared memory cyclic model is shown in Figure 2 and uses an unconfirmed push model performed periodically.

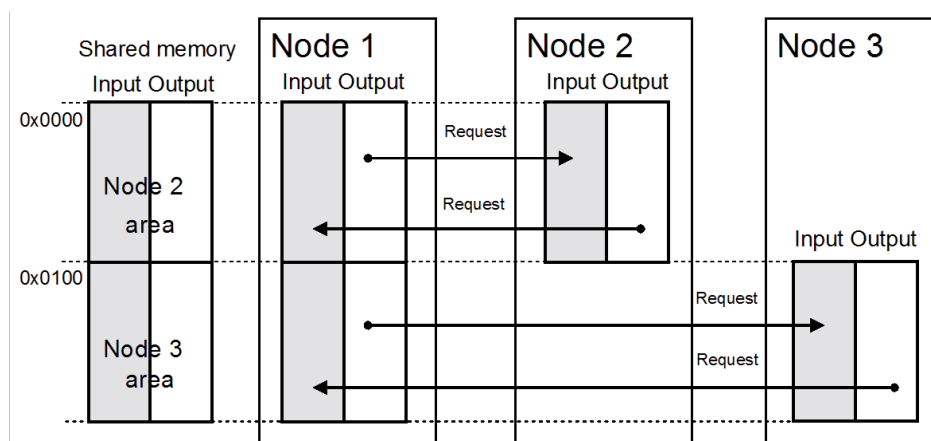


Figure 2 – Cyclic model (1:n type distributed shared memory, unconfirmed push model)

6.1.4 Transient model

The transient model is the client server model shown in Figure 3 and the push model shown in Figure 4.

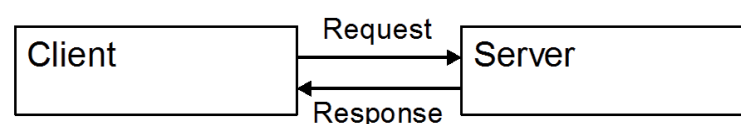


Figure 3 – Transient model (Client server model)

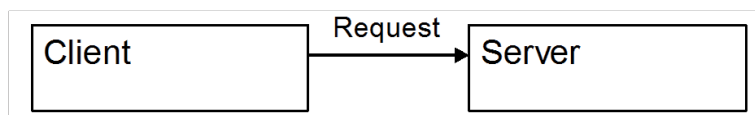


Figure 4 – Transient model (Push model)

6.2 ASE

6.2.1 Overview type C

The structure of the ASE type C for FAL type 23 is shown in Figure 5.

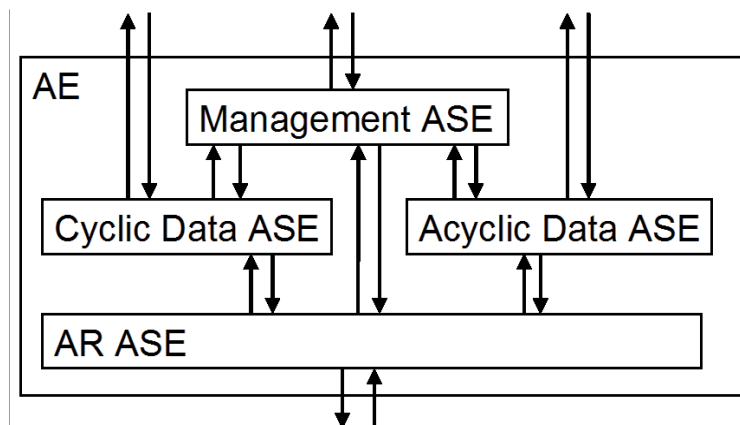


Figure 5 – Structure of ASE type C of FAL type 23

6.2.2 Overview type F

The structure of the ASE type F for FAL type 23 is shown in Figure 6.

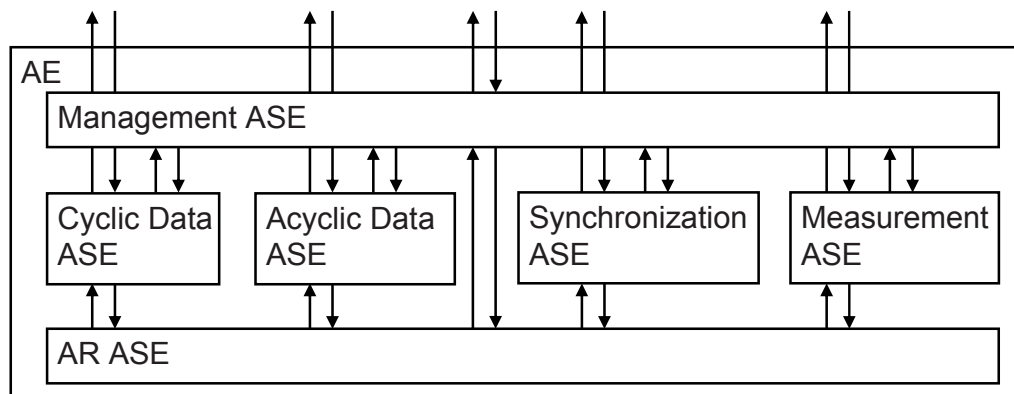


Figure 6 – Structure of ASE type F of FAL type 23

6.2.3 Cyclic data ASE type C

6.2.3.1 Overview

The cyclic data ASE represents a distributed shared memory model which is realized using the cyclic data transmissions. The cyclic transmission is performed to read and write data periodically.