DEUTSCHE NORM September 2008

DIN EN 61158-6-13

ICS 35.100.70; 35.160

Ersatzvermerk
siehe unten

Industrielle Kommunikationsnetze – Feldbusse – Teil 6-13: Protokollspezifikation des Application Layer (Anwendungsschicht) – Typ 13-Elemente (IEC 61158-6-13:2007); Englische Fassung EN 61158-6-13:2008, nur auf CD-ROM

Industrial communication networks –
Fieldbus specifications –
Part 6-13: Application layer protocol specification – Type 13 elements
(IEC 61158-6-13:2007);
English version EN 61158-6-13:2008, only on CD-ROM

Réseaux de communication industriels –
Spécifications des bus de terrain –
Partie 6-13: Spécification des services des couches d'application – Eléments de type 13
(CEI 61158-6-13:2007);
Version anglaise EN 61158-6-13:2008, seulement en CD-ROM

Ersatzvermerk

Mit DIN EN 61158-6-2:2008-09, DIN EN 61158-6-3:2008-09, DIN EN 61158-6-4:2008-09, DIN EN 61158-6-5:2008-09, DIN EN 61158-6-7:2008-09, DIN EN 61158-6-8:2008-09, DIN EN 61158-6-9:2008-09, DIN EN 61158-6-10:2008-09, DIN EN 61158-6-11:2008-09, DIN EN 61158-6-12:2008-09, DIN EN 61158-6-14:2008-09, DIN EN 61158-6-15:2008-09, DIN EN 61158-6-16:2008-09, DIN EN 61158-6-17:2008-09, DIN EN 61158-6-18:2008-09, DIN EN 61158-6-19:2008-09 und DIN EN 61158-6-20:2008-09 Ersatz für DIN EN 61158-6:2005-05
Siehe jedoch Beginn der Gültigkeit

Gesamtumfang 69 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE

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Full document details: DIN EN 61158-6-13:2008-09

Beginn der Gültigkeit

Die von CENELEC am 2008-02-01 angenommene EN 61158-6-13 gilt als DIN-Norm ab 2008-09-01.

Daneben darf DIN EN 61158-6:2005-05 noch bis 2011-02-01 angewendet werden.

Nationales Vorwort

Mit DIN EN 61158-6-2:2008-09, DIN EN 61158-6-3:2008-09, DIN EN 61158-6-4:2008-09, DIN EN 61158-6-5:2008-09, DIN EN 61158-6-7:2008-09, DIN EN 61158-6-8:2008-09, DIN EN 61158-6-9:2008-09, DIN EN 61158-6-10:2008-09, DIN EN 61158-6-11:2008-09, DIN EN 61158-6-12:2008-09, DIN EN 61158-6-14:2008-09, DIN EN 61158-6-15:2008-09, DIN EN 61158-6-16:2008-09, DIN EN 61158-6-17:2008-09, DIN EN 61158-6-18:2008-09, DIN EN 61158-6-19:2008-09 und DIN EN 61158-6-20:2008-09 Ersatz für DIN EN 61158-6:2005-05.

Vorausgegangener Norm-Entwurf: E DIN EN 61158-600:2006-11.

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

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

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

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

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

Der Zusammenhang der zitierten Normen mit den entsprechenden Deutschen Normen ergibt sich, soweit ein Zusammenhang besteht, grundsätzlich über die Nummer der entsprechenden IEC-Publikation. Beispiel: IEC 60068 ist als EN 60068 als Europäische Norm durch CENELEC übernommen und als DIN EN 60068 ins Deutsche Normenwerk aufgenommen.

Einführung

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

Die vorliegende Norm legt das Protokoll des Application Layer für einen Feldbus des Typs 13 (ETHERNET Powerlink) fest. Dieser war in den unten aufgeführten früheren Ausgaben nicht enthalten.

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Änderungen

Gegenüber DIN EN 61158-6:2005-05 wurden folgende Änderungen vorgenommen:

a) Streichung des Typ 6-Feldbusses wegen zu geringer Marktbedeutung;

b) Hinzufügung von weiteren Feldbustypen;

c) Aufteilung in mehrere Teile, jeweils als 6-2, 6-3, …, 6-20 benummert.

Frühere Ausgaben

DIN V 19245-1: 1988-01
DIN 19245-1: 1991-04
DIN 19245-2: 1991-04
DIN EN 50170-1: 1997-07
DIN EN 50170-2: 1997-07
DIN EN 50170-3: 1997-07
DIN EN 50254: 1999-07
DIN EN 50170/A1: 2002-11
DIN EN 50170/A2: 2000-08
DIN EN 50170/A3: 2002-11
DIN EN 61158-6: 2005-05

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EUROPÄISCHE NORM

EUROPEAN STANDARD

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EN 61158-6-13

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Deutsche Fassung

Industrielle Kommunikationsnetze – Feldbusse – Teil 6-13: Protokollspezifikation des Application Layer (Anwendungsschicht) – Typ 13-Elemente

(IEC 61158-6-13:2007)

Industrial communication networks – Fieldbus specifications – Part 6-13: Application layer protocol specification – Type 13 elements
(IEC 61158-6-13:2007)

Réseaux de communication industriels – Spécifications des bus de terrain – Partie 6-13: Spécification des services des couches d'application – Eléments de type 13
(CEI 61158-6-13:2007)

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

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

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

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

CENELEC

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

Zentralsekretariat: rue de Stassart 35, B-1050 Brüssel

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Vorwort

Der Text des Schriftstücks 65C/476/FDIS, zukünftige 1. Ausgabe von IEC 61158-6-13, ausgearbeitet von dem SC 65C „Industrial networks“ des IEC/TC 65 „Industrial-process measurement, control and automation“, wurde der IEC-CENELEC Parallelen Abstimmung unterworfen und von CENELEC am 2008-02-01 als EN 61158-6-13 angenommen.

Dieser und die weiteren Teile der Normenreihe EN 61158-6 ersetzen EN 61158-6:2004.

Gegenüber EN 61158-6:2004 wurden die folgenden Änderungen durchgeführt:

– Streichung des Typ 6-Feldbusses wegen zu geringer Marktbedeutung;
– Hinzufügung von weiteren Feldbustypen;
– Aufteilung in mehrere Teile, jeweils als 6-2, 6-3, …, 6-20 benummert.

Nachstehende Daten wurden festgelegt:

– spätestes Datum, zu dem die EN auf nationaler Ebene durch Veröffentlichung einer identischen nationalen Norm oder durch Anerkennung übernommen werden muss (dop): 2008-11-01

– spätestes Datum, zu dem nationale Normen, die der EN entgegenstehen, zurückgezogen werden müssen (dow): 2011-02-01

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

Der Anhang ZA wurde von CENELEC hinzugefügt.

Anerkennungsnotiz

Der Text der Internationalen Norm IEC 61158-6-13:2007 wurde von CENELEC ohne irgendeine Abänderung als Europäische Norm angenommen.

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

IEC 60559	ANMERKUNG	Harmonisiert als HD 592 S1:1991 (nicht modifiziert).
IEC 61784-2	ANMERKUNG	Harmonisiert als EN 61784-2:2008 (nicht modifiziert).

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INTRODUCTION

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

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

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-13: Application layer protocol specification – Type 13 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 13 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 specifies interactions between remote applications and defines the externally visible behavior provided by the Type 13 fieldbus application layer in terms of

a) the formal abstract syntax defining the application layer protocol data units conveyed between communicating application entities;
b) the transfer syntax defining encoding rules that are applied to the application layer protocol data units;
c) the application context state machine defining the application service behavior visible between communicating application entities;
d) the application relationship state machines defining the communication behavior visible between communicating application entities.

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

1) define the wire-representation of the service primitives defined in IEC 61158- 5-13, and
2) define the externally visible behavior associated with their transfer.

This standard specify the protocol of the Type 13 fieldbus application layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498) and the OSI application layer structure (ISO/IEC 9545).

1.2 Specifications

The principal objective of this standard is to specify the syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-13.

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 IEC 61158-6.

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. Conformance is achieved through implementation of this application layer protocol specification.

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2 Normative references

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

IEC 61158-3-13, *Industrial communication networks – Fieldbus specifications - Part 3-13: Data-link layer service definition – Type 13 elements*

IEC 61158-4-13, *Industrial communication networks – Fieldbus specifications - Part 4-13: Data-link layer protocol specification – Type 13 elements*

IEC 61158-5-13, *Industrial communication networks – Fieldbus specifications - Part 5-13: Application layer service definition – Type 13 elements*

ISO/IEC 7498 (all parts), *Information technology – Open Systems Interconnection – Basic Reference Model*

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

ISO/IEC 8824, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1)*

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

3 Terms, definitions, symbols, abbreviations and conventions

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

3.1 ISO/IEC 7498-1 terms

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

3.1.1
application entity

3.1.2
application process

3.1.3
application protocol data unit

3.1.4
application service element

3.1.5
application entity invocation

3.1.6
application transaction

3.1.7
transfer syntax

3.2 ISO/IEC 8822 terms

For the purposes of this document, the following term as defined in ISO/IEC 8822 applies:

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3.2.1
abstract syntax

3.3 ISO/IEC 9545 terms

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

3.3.1
application-context

3.3.2
application-process-type

3.3.3
application-service-element

3.3.4
application control service element

3.4 ISO/IEC 8824 terms

For the purposes of this document, the following terms as defined in ISO/IEC 8824 apply:

3.4.1
any type

3.4.2
bitstring type

3.4.3
boolean type

3.4.4
choice type

3.4.5
false

3.4.6
integer type

3.4.7
module

3.4.8
null type

3.4.9
object identifier

3.4.10
octetstring type

3.4.11
production

3.4.12
simple type

3.4.13
sequence of type

3.4.14
sequence type

3.4.15
structured type

3.4.16
tag

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3.4.17
tagged type

3.4.18
true

3.4.19
type

3.5 Terms and definitions from IEC 61158-5-13

3.5.1
application relationship

3.5.2
client

3.5.3
error class

3.5.4
publisher

3.5.5
server

3.5.6
subscriber

3.6 Other terms and definitions

The following terms and definitions are used in this standard:

3.6.1
receiving
service user that receives a confirmed primitive or an unconfirmed primitive, or a service provider that receives a confirmed APDU or an unconfirmed APDU

3.6.2
resource
processing or information capability of a subsystem

3.6.3
sending
service user that sends a confirmed primitive or an unconfirmed primitive, or a service provider that sends a confirmed APDU or an unconfirmed APDU

3.6.4
managing node
node that can manage the SCNM mechanism

3.6.5
controlled node
node without the ability to manage the SCNM mechanism

4 FAL syntax description

4.1 General

This description of the Type 13 abstract syntax uses formalisms similar to ASN.1, although the encoding rules differ from that standard.

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4.2 FAL-AR PDU abstract syntax

4.2.1 Top level definition

```
APDU ::= CHOICE {
        [3] Isoc1
        [4] Isoc2
        [5] Asyn1
        [6] Asyn2
}
```

4.2.2 Isoc1

```
Isoc1 ::= SEQUENCE {
        message-type
        destination
        source
        reserved
        signaling-flags
        PDO-version
        reserved8
        size
        PDO-payload
}
```

4.2.3 Isoc2

```
Isoc2 ::= SEQUENCE {
        message-type
        destination
        source
        NMT-status
        signaling-flags
        PDO-version
        reserved8
        size
        PDO-payload
}
```

4.2.4 Asyn1

```
Asyn1 ::= SEQUENCE {
        message-type
        destination
        source
        NMT-status
        signaling-flags
        requested-service-ID
        requested-service-target
        EPL-version
}
```


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4.2.5 Asyn2

```
Asyn2 ::= SEQUENCE {
   message-type
   destination
   source
   service-ID
   pduBody        CHOICE {
      [1h] ident-response
      [2h] status-response
      [3h] NMT-request
      [4h] NMT-command
      [5h] SDO
      [A0h...FEh] manufacturer-specific
      [FFh] reserved
   }
}
```

4.2.6 Message-type

message-type ::= Unsigned8 — Contains the context specific APDU tags

4.2.7 Addresses

destination ::= Unsigned8 — Node address (1...255)
source ::= Unsigned8 — Node address (1...255)

4.2.8 Service-ID

service-ID ::= Unsigned8 — Contains the context specific tags for the pduBody

4.2.9 Reserved8

reserved8 ::= Unsigned8

4.2.10 Reserved16

reserved16 ::= Unsigned16

4.2.11 Reserved24

reserved24 ::= Unsigned24

4.2.12 Signaling-flags

```
signaling-flags ::= BitString {
   RD             (0)
   ER             (1)
   EA             (2)
   EC             (3)
   EN             (4)
   MS             (5)
   PS             (6)
   MC             (7)
   RS_bit1        (8)
   RS_bit2        (9)
   RS_bit3        (10)
   PR_bit1        (11)
   PR_bit2        (12)
   PR_bit3        (13)
   reserved       (14)
   reserved       (15)
}
```

The different APDU types use the flags as listed in Table 1. In all cases without "x" the flags are present but not written resp. interpreted.

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Table 1 – Use of signaling-flags

	Isoc1	Isoc2	Asyn1	Id.Resp.	St.Resp.
RD	x	x			
ER			x		
EA	x		x		
EC					x
EN		x			x
MS	x	x			
PS					
MC					
RS	x	x		x	x
PR	x	x		x	x

The usage of these flags is specified in IEC 61158-3-13 and IEC 61158-4-13.

4.2.13 PDO-version

PDO-version ::= Unsigned8 — High nibble: main version; low nibble: sub version

4.2.14 Size

size ::= Unsigned8 — Size of PDO payload; max. 1490 octets due to Ethernet restrictions and protocol overhead

4.2.15 PDO-payload

PDO-payload ::= Any

4.2.16 NMT-status

```
NMT-status ::= CHOICE {
   NMT_GS_OFF                  Unsigned8 ::= 0000 0000b
   NMT_xS_NOT_ACTIVE           Unsigned8 ::= 0001 1100b
   NMT_xS_PRE_OPERATIONAL_1    Unsigned8 ::= 0001 1101b
   NMT_xS_PRE_OPERATIONAL_2    Unsigned8 ::= 0101 1101b
   NMT_xS_READY_TO_OPERATE     Unsigned8 ::= 0110 1101b
   NMT_xS_OPERATIONAL          Unsigned8 ::= 1111 1101b
   NMT_xS_STOPPED              Unsigned8 ::= 0100 1101b
   NMT_xS_BASIC_ETHERNET       Unsigned8 ::= 0001 1110b
}
```

NOTE If sender = MN: "x" := "M"; if sender = CN: "x" := "C"

4.2.17 Requested-service-ID

```
requested-service-ID ::= CHOICE {
   no-service                  [0h] IMPLICIT Unsigned8
   ident-request               [1h] IMPLICIT Unsigned8
   status-request              [2h] IMPLICIT Unsigned8
   NMT-req-inv                 [3h] IMPLICIT Unsigned8
   manufacturer-specific       [A0h]... [FEh] IMPLICIT Unsigned8
   unspecified-invite          [FFh] IMPLICIT Unsigned8
}
```

4.2.18 Requested-service-target

requested-service-target ::= Unsigned8 — Node address (1...255); not assigned (0)

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4.2.19 EPL-version

EPL-version ::= Unsigned8 — High nibble: main version; low nibble: sub version

4.3 Abstract syntax of Asyn2 pduBody

4.3.1 Ident-response

4.3.1.1 Overview

```
Ident-response ::= SEQUENCE {
   signaling-flags
   NMT-status
   reserved8
   EPL-version
   reserved8
   feature-flags                BitString          — (see 4.3.1.2)
   MTU                          Unsigned16         — size of the largest possible IP frame incl. header
   poll-in-size                 Unsigned16         — actual CN setting for Isoc1 data block size
   poll-out-size                Unsigned16         — actual CN setting for Isoc2 data block size
   response-time                Unsigned32         — time required by the CN to respond to Isoc1
   reserved16
   device-type                  Unsigned32         — CN's device type
   vendor-ID                    Unsigned32         — CN's vendor ID
   product-code                 Unsigned32         — CN's product code
   revision-number              Unsigned32         — CN's revision number
   serial-number                Unsigned32         — CN's serial number
   vendor-specific-extension-1  Unsigned64         — for vendor specific purpose, to be filled with zeros if not used
   verify-configuration-date    Unsigned32         — CN's configuration date
   verify-configuration-time    Unsigned32         — CN's configuration time
   application-sw-date          Unsigned32         — CN's application software date
   application-sw-time          Unsigned32         — CN's application software time
   IP-address                   Unsigned32         — current IP address value of the CN
   subnet-mask                  Unsigned32         — current IP subnet mask of the CN
   default-gateway              Unsigned32         — current IP default gateway of the CN
   host-name                    VisibleString32    — current DNS host name of the CN
   vendor-specific-extension-2  SEQUENCE SIZE(64) OF Unsigned64
                                                   —for vendor specific purpose, to be filled with zeros if not in use
}
```

NOTE Some of the above listed elements are sometimes summarized as follows:
"poll-in-size" through "response-time" are summarized under the term "cycle-timing",
"device-type" through "serial-number" under "identity",
"verify-configuration-date" and "verify-configuration-time" under "verify-configuration",
"application-sw-date" and "application-sw-time" under "application-software-version",
"vendor-specific-extension-1" and "vendor-specific-extension-2" under "vendor-specific-extensions",
"IP-address" through "default-gateway" under "IP-address",

4.3.1.2 Feature-flags

```
feature-flags ::= BitString {
   Isochronous                  (0)        — device may be isochronously accessed via Isoc1
   SDO by UDP/IP                (1)        — device supports SDO communication via UDP/IP
   SDO by ASnd                  (2)        — device supports SDO communication via ASnd
   reserved for future use      (3)
   NMT-info services            (4)        — device supports NMT Info Services
   Extended NMT-state-commands  (5)        — device supports Extended NMT State Commands
   Dynamic PDO mapping          (6)        — device supports dynamic PDO Mapping
   NMT services by UDP/IP       (7)        — device supports NMT Services by UDP/IP
   Configuration manager        (8)        — device supports Configuration Manager functions
   Multiplexed access           (9)        — CN device supports multiplexed isochronous access.
   Node-ID setup by SW          (10)       — device supports NodeID setup by software
   MN basic ethernet mode       (11)       — MN device supports Basic Ethernet Mode
   Routing Type 1 support       (12)       — device supports Routing Type 1 functions
   Routing Type 2 support       (13)       — device supports Routing Type 2 functions
   reserved_bit1 through bit18  (13)...(31)
}
```


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4.3.2 Status-response

4.3.2.1 Overview

```
Status-response ::= SEQUENCE {
   signaling-flags
   NMT-status
   reserved24
   static-error-bit-field
   List-of-errors
}
```

4.3.2.2 Static-error-bitf ield

```
static-error-bit-field ::= SEQUENCE {
   error-register          BitString                          — (see 4.3.2.3)
   reserved8
   specific-errors         SEQUENCE SIZE (n) OF Unsigned8     — Device profile or vendor specific errors
                                                                n depends on device configuration
}
```

4.3.2.3 Error-register

```
error-register ::= BitString {
   Generic error           (0)          — 0, if no static error present, else 1
   Current                 (1)   OPTIONAL
   Vorltage                (2)   OPTIONAL
   Temperature             (3)   OPTIONAL
   Communication error     (4)   OPTIONAL
   Device profile specific (5)   OPTIONAL
   reserved                (6)   OPTIONAL   — always 0
   Manufacturer specific   (7)   OPTIONAL
}
```

4.3.2.4 List-of-errors

```
List-of-errors ::= SEQUENCE SIZE (k) OF ErrorEntry     — k :>= 2, depends on device configuration
```

4.3.2.5 ErrorEntry

```
ErrorEntry ::= SEQUENCE {
   error-type              Unsigned16   — (see 4.3.2.6)
   error-code              Unsigned16   — (see 4.3.2.6 and A.3)
   time-stamp              Unsigned64
   additional-information  Unsigned64
}
```

4.3.2.6 Error-type

The possible values in error-type and their meaning are listed in Table 2.

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Table 2 – Values of error-type

Octet	Bit	Value	Description
0 .. 1	15 (status)	0b	ERR_History_ADOM Entry
		1b	Status entry in Status-response frame (Bit 14 shall be set to 0b)
	14 (send)	0b	ERR_History_ADOM only
		1b	Additional to the ERR_History_ADOMthe entry shall also be entered in to the emergency queue of the error signaling
	13 .. 12 (mode)	0h	Not allowed in ERR_History_ADOM. Entries with this mode may only be used by the error signaling itself to indicate the termination of the history entries in the Status-response frame
		1h	An error has occurred and is active (e.g. short circuit of output detected)
		2h	An active error was cleared (e.g. no short circuit anymore) (not allowed for status entries)
		3h	An error / event occurred (not allowed for status entries)
	11 .. 0 (profile)	000h	Reserved
		001h	error-code contains a vendor specific error code
		002h	error-code contains Type 13 network specific communication profile errors (see A.3)
		003h .. FFFh	error-code contains device profile specific errors

4.3.3 NMT-request

```
NMT-request ::= SEQUENCE {
   NMT-requested-command-ID          Unsigned8          — value range see A.2
   NMT-requested-command-target      Unsigned8          — target node address
   NMT-requested-command-data        Any
}
```

4.3.4 NMT-command

```
NMT-command ::= SEQUENCE {
   NMT-command-ID CHOICE {                              — value range see A.2
      NMT-state-command                Unsigned8
      NMT-info                         Unsigned8
   }
   reserved8
   NMT-command-data   CHOICE {
      date-time                        TimeOfDay        — only if NMT-command-ID = B0h; see A.4
      node-states        SEQUENCE SIZE (255) OF Unsigned8 — if NMT-command-ID = 96h; see A.4;
                                                          reports each node state individually
      EPL-node-list                                     — if NMT-command-ID = 40h...95h, A0h;
                                                          see A.4
      NULL                                              — else
   }
}
```

4.3.5 SDO

4.3.5.1 Overview

```
SDO ::= SEQUENCE {
   SequenceLayer
   CommandLayer
}
```


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4.3.5.2 SequenceLayer

```
SequenceLayer ::= SEQUENCE {
   SequenceFlags     Bitstring {
      rcon_bit1                        (0)      — 0: no connection; 1: initialisation; 2: connection valid
      rcon_bit2                        (1)         3: error response (retransmission requested)
      rsnr_bit1                        (2)      — 0..63
      rsnr_bit2                        (3)
      rsnr_bit3                        (4)
      rsnr_bit4                        (5)
      rsnr_bit5                        (6)
      rsnr_bit6                        (7)
      scon_bit1                        (8)      — 0: no connection; 1: initialisation; 2: connection valid
      scon_bit2                        (9)         3: connection valid with acknowledge request
      ssnr_bit1                        (10)     — 0..63
      ssnr_bit2                        (11)
      ssnr_bit3                        (12)
      ssnr_bit4                        (13)
      ssnr_bit5                        (14)
      ssnr_bit6     (15)
   }
   reserved16
}
```

4.3.5.3 CommandLayer

```
CommandLayer ::= SEQUENCE {
   SDOCommandHeader          SEQUENCE {
      reserved8
      invoke-ID
      segmentation_abort_response
      command-ID
      segment-size
      reserved16
   }
   SDO-command      CHOICE {
      write-by-index-request              [1h] IMPLICIT WriteByIndex-RequestPDU
      read-by-index-request               [2h] IMPLICIT ReadByIndex-RequestPDU
      write-all-by-index-request          [3h] IMPLICIT WriteAllByIndex-RequestPDU
      read-all-by-index-request           [4h] IMPLICIT ReadAllByIndex-RequestPDU
      write-multiple-by-index-request     [31h] IMPLICIT WriteMultipleByIndex-RequestPDU
      read-multiple-by-index-request      [32h] IMPLICIT ReadMultipleByIndex-RequestPDU
      abort                               IMPLICIT AbortPDU
      write-by-index-response             [1h] IMPLICIT WriteByIndex-ResponsePDU
      read-by-index-response              [2h] IMPLICIT ReadByIndex-ResponsePDU
      write-all-by-index-response         [3h] IMPLICIT WriteAllByIndex-ResponsePDU
      read-all-by-index-response          [4h] IMPLICIT ReadAllByIndex-ResponsePDU
      write-multiple-by-index-response    [31h] IMPLICIT WriteMultipleByIndex-ResponsePDU
      read-multiple-by-index-response     [32h] IMPLICIT ReadMultipleByIndex-ResponsePDU
   }
}
```

4.3.5.4 Invoke ID

```
invoke-ID ::= Unsigned8
```

4.3.5.5 Segmentation_abort_response

```
segmentation_abort_response ::= BitString {
   reserved                            (0)
   reserved                            (1)
   reserved                            (2)
   reserved                            (3)
   segmentation_bit1                   (4)      — 0: Expedited transfer; 1: initiate segment transfer
   segmentation_bit2                   (5)         2: segment; 3: segment transfer complete
   abort                               (6)      — 0: transfer ok; 1: abort
   response                            (7)      — 0: request; 1: response
}
```

4.3.5.6 Command-ID

```
command-ID ::= Unsigned8                    —  Contains context specific tag for SDO-command
```


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