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**Entwurf**

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E DIN EN 61158-100-26:2016-07  
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**Industrielle Kommunikationsnetze –  
Profile –**

**Teil 2: Zusätzliche Feldbusprofile für Echtzeitnetzwerke basierend auf  
ISO/IEC 8802-3**

**(IEC 65C/863A/CDV:2017);**

**Englische Fassung prEN 61784-2:2017, nur auf CD-ROM**

Industrial communication networks –  
Profiles –

Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3  
(IEC 65C/863A/CDV:2017);

English version prEN 61784-2:2017, only on CD-ROM

Réseaux de communication industriels –  
Profils –

Partie 2: Profils de bus de terrain supplémentaires pour les réseaux en temps réel basés  
sur l'ISO/CEI 8802-3

(IEC 65C/863A/CDV:2017);

Version anglaise prEN 61784-2:2017, seulement en CD-ROM

**Anwendungswarnvermerk**

Dieser Norm-Entwurf mit Erscheinungsdatum 2018-01-26 wird der Öffentlichkeit zur Prüfung und  
Stellungnahme vorgelegt.

Weil die beabsichtigte Norm von der vorliegenden Fassung abweichen kann, ist die Anwendung dieses  
Entwurfs besonders zu vereinbaren.

Stellungnahmen werden erbeten

- vorzugsweise online im Norm-Entwurfs-Portal von DIN unter [www.din.de/go/entwuerfe](http://www.din.de/go/entwuerfe) bzw. für Norm-Entwürfe der DKE auch im Norm-Entwurfs-Portal der DKE unter [www.entwuerfe.normenbibliothek.de](http://www.entwuerfe.normenbibliothek.de), sofern dort wiedergegeben;
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- oder in Papierform an die DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE, Stresemannallee 15, 60596 Frankfurt am Main.

Die Empfänger dieses Norm-Entwurfs werden gebeten, mit ihren Kommentaren jegliche relevanten  
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Gesamtumfang 327 Seiten

DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik in DIN und VDE

## Nationales Vorwort

Die englische Fassung des europäischen Dokuments prEN 61784-2:2017 „Industrielle Kommunikationsnetze – Profile – Teil 2: Zusätzliche Feldbusprofile für Echtzeitnetzwerke basierend auf ISO/IEC 8802-3“ (Entwurf in der Umfrage) ist unverändert in diesen Norm-Entwurf übernommen worden.

Die Internationale Elektrotechnische Kommission (IEC) und das Europäische Komitee für Elektrotechnische Normung (CENELEC) haben vereinbart, dass ein auf IEC-Ebene erarbeiteter Entwurf für eine Internationale Norm zeitgleich (parallel) bei IEC und CENELEC zur Umfrage (CDV-Stadium) und Abstimmung als FDIS (en: Final Draft International Standard) bzw. Schluss-Entwurf für eine Europäische Norm gestellt wird, um eine Beschleunigung und Straffung der Normungsarbeit zu erreichen. Dem entsprechend ist das internationale Dokument IEC 65C/863A/CDV:2017 „Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3“ unverändert in den Entwurf prEN 61784-2:2017 übernommen worden.

Das internationale Dokument wurde vom SC 65C „Industrial networks“ der Internationalen Elektrotechnischen Kommission (IEC) erarbeitet.

Bei der Abstimmung zu dem Europäischen Schluss-Entwurf bei CENELEC und dem Internationalen Schluss-Entwurf bei IEC [Final Draft International Standard (FDIS)] sind jeweils nur „JA/NEIN“-Entscheidungen möglich, wobei „NEIN“-Entscheidungen fundiert begründet werden müssen. Dokumente, die bei CENELEC als Europäische Norm angenommen und ratifiziert werden, sind unverändert als Deutsche Normen zu übernehmen.

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

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

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

Das Präsidium des DIN hat mit Präsidialbeschluss 1/2004 festgelegt, dass DIN-Normen, deren Inhalt sich auf internationale Arbeitsergebnisse der Informationsverarbeitung gründet, unter bestimmten Bedingungen allein in englischer Sprache veröffentlicht werden dürfen. Diese Bedingungen sind für den vorliegenden Norm-entwurf erfüllt.

Da sich die Benutzer des vorliegenden Normentwurfs der englischen Sprache als Fachsprache bedienen, wird die englische Fassung der prEN 61784-2 veröffentlicht. Zu deren Abschnitt 1, der den Anwendungsbereich festlegt, und deren Abschnitt 3, der die Begriffe festlegt, wurde eine Übersetzung angefertigt und als informativer Nationaler Anhang NA des vorliegenden Normentwurfs hinzugefügt. Für viele der verwendeten Begriffe existieren keine gebräuchlichen deutschen Benennungen, da sich die deutschen Anwender in der Regel ebenfalls der englischen Benennungen bedienen. Dieser Normentwurf steht nicht in unmittelbarem Zusammenhang mit Rechtsvorschriften und ist nicht als Sicherheitsnorm anzusehen.

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

Es wird auf die Möglichkeit hingewiesen, dass einige Elemente dieses Dokuments Patentrechte berühren können. ISO [und/oder] IEC sind nicht dafür verantwortlich, einige oder alle diesbezüglichen Patentrechte zu identifizieren.

## Änderungen

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

- a) Im gesamten Dokument Aktualisierung der datierten Verweisungen bezüglich der IEC 61158 Reihe, IEC 61784-1, IEC 61784-3 Reihe, IEC 61784-5 Reihe und der IEC 61918,
- b) Aktualisierung der Auswahltablelle CPF 2, CPF 3, CPF 4, CPF 8 und CPF 17
- c) CPF 3: Aktualisierung der Anforderungen aller Konformitätsklassen,
- d) CPF 3 Aktualisierung der Timing-Anforderungen für IO-Geräte,
- e) CPF 3: Verfeinerung der hinzugefügten Anwendungsklassen,
- f) Ergänzung einer neuen Kommunikationsprofilfamilie CPF 20 in Abschnitt 21,
- g) Ergänzung einer neuen Kommunikationsprofilfamilie CPF 21 in Abschnitt 22.

## Nationaler Anhang NA (informativ)

### Auszugsweise Übersetzung<sup>N1)</sup>

#### 1 Anwendungsbereich

Dieser Teil der IEC 61784 legt Folgendes fest:

- Leistungskennzahlen zur Unterstützung von Klassifizierungsschemata für Anforderungen an das Echtzeit-Ethernet;
- Profile und verwandte Netzwerkkomponenten auf Grundlage von ISO/IEC 8802-3 oder IEEE 802.3, der IEC 61158 Normenreihe und IEC 61784-1;
- RTE-Lösungen, die parallel zu Anwendungen nach ISO/IEC 8802-3 oder IEEE 802.3 laufen können.

Diese Kommunikationsprofile werden als Echtzeit-Ethernet-Kommunikationsprofile bezeichnet.

ANMERKUNG Die RTE-Kommunikationsprofile nutzen Kommunikationsnetzwerke und verwandte Netzwerkkomponenten nach ISO/IEC 8802-3 oder IEEE 802.3 oder IEC 61588. In einigen Fällen kann eine Anpassung dieser Normen erfolgt sein, um RTE-Merkmale zu erhalten.

#### 3 Begriffe, Abkürzungen und Vereinbarungen

##### 3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die Begriffe nach ISO/IEC 8802-3, IEEE 802, IEEE 802.1AB, IEEE 802.1AS, IEEE 802.1D, IEEE 802.1Q und IEEE 802.3 und die folgenden Begriffe.

###### 3.1.1

**aktives Netz** (en: active network)

Netz, in dem die Datenübertragung zwischen nicht direkt verbundenen Geräten von aktiven Elementen in den Geräten abhängt, die die Verbindung herstellen

[QUELLE: IEC 61918:201X, 3.1.3]

###### 3.1.2

**Kommunikationszyklus** (en: communication cycle)

<CPF 16>

festgelegte Zeitdauer zwischen zwei Master-Synchronisationstelegrammen

###### 3.1.3

**Zyklisch** (en: cyclic)

sich regelmäßig wiederholend

###### 3.1.4

**Domäne** (en: domain)

<CPF 10>

Teil des Netzwerks, der aus einem oder zwei Subnetzen besteht

Anmerkung 1 zum Begriff: Zwei Subnetze sind für ein zweifach redundantes Netzwerk erforderlich und jede Endstation in der Domäne ist mit beiden Subnetzen verbunden.

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<sup>N1)</sup> Nationale Fußnote: Die Nummerierung des IEC-Schriftstücks 65C/863A/CDV:2017-06 wurde beibehalten.

### 3.1.5

**Endstation** (en: end-station)

an ein Netzwerk angeschlossenes System, das eine erste Quelle oder ein letztes Ziel von MAC-Rahmen, die über dieses Netzwerk übertragen werden, ist

Anmerkung 1 zum Begriff: Aus der Sicht des Netzwerks ist ein Router der Netzwerkschicht eine Endstation. Ein Switch stellt in seiner Funktion zur Weiterleitung von MAC-Rahmen von einem Verbindungszweig auf einen anderen Verbindungszweig keine Endstation dar.

### 3.1.6

**Feldbereich** (en: field area)

Bereich am Ort der Produktion oder des Prozesses, in dem Feldgeräte angeordnet sind

### 3.1.7

**Rahmen** (en: frame)

Datenübertragungseinheit auf der MAC-Unterschicht (en: media access control) basierend auf ISO/IEC 8802-3, die eine Protokolldateneinheit (en: protocol data unit; PDU) zwischen MAC-Dienstbenutzern übermittelt

[QUELLE: IEEE 802.1Q]

### 3.1.1 3.1.8

**Identifikationsnummer** (en: identification number; IDN)

<CPF 16>

Kennzeichnung von Betriebsdaten, unter der ein Datenblock mit seinem Attribut, seinem Namen, seiner Einheit, seinen minimalen und maximalen Eingabewerten und den Daten aufbewahrt wird

### 3.1.9

**IP-Kanal** (en: IP channel)

<CPF 16>

festgelegtes Zeitfenster innerhalb des Kommunikationszyklus, in dem Ethernet-Protokollrahmen basierend auf ISO/IEC 8802-3 weitergegeben werden (Nicht-Echtzeit-Kommunikation)

### 3.1.10

**Jitter** (en: jitter)

zeitliche Veränderung des Taktsignals oder zeitliche Veränderung eines anderen regelmäßigen Ereignisses

### 3.1.11

**lineare Topologie** (en: linear topology)

Topologie, in der die Knoten hintereinander geschaltet sind, wobei zwei Knoten lediglich mit jeweils einem weiteren Knoten und alle anderen Knoten jeweils mit zwei weiteren Knoten verbunden sind (entspricht einer Verbindung in Form einer Linie)

[QUELLE: IEC 61918:201X, 3.1.44]

### 3.1.12

**Verbindung** (en: link)

Übertragungspfad zwischen zwei benachbarten Knoten

[QUELLE: abgeleitet von ISO/IEC 11801]

### 3.1.13

**logische Doppellinie** (en: logical double line)

<CPF 18>

Reihung des Root-Gerätes und sämtlicher gewöhnlicher Geräte, die die Kommunikations-DLPDU in Vorwärts- und Rückwärtsrichtung verarbeiten

### 3.1.14

**Master** (en: master)

<CPF 16>

Knoten, der den anderen Knoten das Recht zur Übertragung zuweist

### 3.1.15

**Nachricht** (en: message)

geordnete Folge von Oktetten für die Übermittlung von Informationen

[QUELLE: abgeleitet von ISO/IEC 2382-16:1996,16.02.01]

Anmerkung 1 zum Begriff: Nachrichten werden normalerweise für die Übermittlung von Informationen zwischen Peers auf dem Application Layer verwendet.

### 3.1.16

**MDT0-Telegramm**

<CPF 16>

Telegramm, mit dem der Master seine Synchronisationsdaten sowie alle seine Echtzeitdaten oder Teile davon an die Slaves überträgt

### 3.1.17

**Knoten** (en: node)

Netzwerkeinheit, die mit einem oder mehreren Verbindungszweigen verbunden ist

Anmerkung 1 zum Begriff: Ein Knoten kann entweder ein Switch, eine Endstation oder eine RTE-Endstation sein.

### 3.1.18

**Paket** (en: packet)

logische Gruppierung von Informationen, die zur Beschreibung einer Dateneinheit auf einer beliebigen Schicht verwendet wird, um die Benutzerdaten der höheren Schicht an die entsprechende Peer-Schicht zu übermitteln

Anmerkung 1 zum Begriff: Im Sinne des OSI-Referenzmodells entspricht ein Paket auf jeder Schicht der PDU. Ein Data-Link Layer Paket ist ein Rahmen.

### 3.1.19

**Echtzeit** (en: real-time)

Fähigkeit eines Systems, ein erforderliches Ergebnis in einer begrenzten Zeit bereitzustellen

### 3.1.20

**Echtzeit-Kommunikation** (en: real-time communication)

Transfer von Daten in Echtzeit

### 3.1.21

**Echtzeit-Ethernet** (en: real-time ethernet; RTE)

Netzwerk, das auf ISO/IEC 8802-3 oder IEEE 802.3 basiert und Echtzeit-Kommunikation unterstützt

Anmerkung 1 zum Begriff: Sofern die Echtzeit-Kommunikation nicht beeinträchtigt wird, können andere Kommunikationsarten unterstützt werden.

Anmerkung 2 zum Begriff: Diese Definition bezieht sich auf ISO/IEC 8802-3, ist aber nicht darauf beschränkt. Sie könnte auch auf andere IEEE-802-Spezifikationen, z. B. IEEE 802.11, anwendbar sein.

### 3.1.22

**RTFL** (en: real time frame line)

<CPF 18>

Kommunikationsmodell mit Geräten, die in einer logischen Doppellinie kommunizieren

### 3.1.23

**RTFN** (en: real time frame network)

<CPF 18>

Kommunikationsmodell mit Geräten, die in einem vermittelten Netzwerk kommunizieren

### 3.1.24

**Ring** (en: ring)

aktives Netz, in dem jeder Knoten mit zwei weiteren Knoten in Reihe geschaltet ist

Anmerkung 1 zum Begriff: Ein Ring kann auch als Schleife bezeichnet werden.

[QUELLE: IEC 61918:201X, 03.01.1963]

### 3.1.25

**Router** (en: router)

<CPF 10>

Zwischeneinrichtung, die zwei oder mehr Subnetze mittels einer Netzwerkschicht-Relais-Funktion verbindet

### 3.1.26

**RTE-Endgerät** (en: RTE end device)

Gerät mit mindestens einer RTE-Endstation

### 3.1.27

**RTE-Endstation** (en: RTE end-station)

Endstation mit RTE-Funktion

### 3.1.28

**Plan** (en: schedule)

zeitliche Einteilung einer Menge von in Beziehung stehenden Operationen

### 3.1.29

**Stern** (en: star)

Netz aus drei oder mehr Geräten, bei dem alle Geräte an einem zentralen Punkt angeschlossen sind

[QUELLE: IEC 61918:201X, 3.1.69, modifiziert – „der aktiv oder passiv sein kann“ wurde gelöscht]

### 3.1.30

**Subnetz** (en: subnetwork)

<CPF 10>

Teil des Netzwerks, der keine Router umfasst

Anmerkung 1 zum Begriff: Ein Subnetz besteht aus Endstationen, Bridges und Segmenten.

Anmerkung 2 zum Begriff: Jede in ein Subnetz eingeschlossene Endstation hat dieselbe IP-Netzwerkadresse.

### 3.1.31

**Switch** (en: subnetwork)

MAC-Bridge nach der Definition in IEEE 802.1Q

### 3.1.32

**Telegramm** (en: telegram)

<CPF 16>

Rahmen

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL COMMUNICATION NETWORKS –  
PROFILES –**

**Part 2: Additional fieldbus profiles for real-time  
networks based on ISO/IEC 8802-3**

**FOREWORD**

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Attention is drawn to the fact that the use of some of the associated protocol types is restricted by their intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders of those rights permits a layer protocol type to be used with other layer protocols of the same type, or in other type combinations explicitly authorized by their respective intellectual property right holders.

NOTE Combinations of protocol types are specified in IEC 61784-1 and IEC 61784-2.

International Standard IEC 61784-2 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This fourth edition cancels and replaces the third edition published in 2014. This edition constitutes a technical revision.

687 The main changes with respect to the previous edition are listed below:

- 688 • update of the dated references to the IEC 61158 series, to IEC 61784-1, to the  
689 IEC 61784-3 series, to the IEC 61784-5 series and to IEC 61918 throughout the document;
- 690 • update of selection tables for CPF 2, CPF 3, CPF 4, CPF 8 and CPF 17;
- 691 • CPF3: update of the requirements for all conformance classes;
- 692 • CPF3: updated timing requirements for IO devices;
- 693 • CPF3: refining the added application classes;
- 694 • addition of a new Communication Profile Family – CPF 20 in Clause 21;
- 695 • addition of a new Communication Profile Family – CPF 21 in Clause 22.

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

|              |                  |
|--------------|------------------|
| FDIS         | Report on voting |
| 65C/xxx/FDIS | 65C/xxx/RVD      |

697  
698 Full information on the voting for the approval of this standard can be found in the report on  
699 voting indicated in the above table.

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

701 A list of all parts of the IEC 61784 series, published under the general title *Industrial*  
702 *communication networks – Profiles*, can be found on the IEC web site.

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

- 706 • reconfirmed,
- 707 • withdrawn,
- 708 • replaced by a revised edition, or
- 709 • amended.

710

The National Committees are requested to note that for this publication the stability date is 2023.

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

711

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

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713

714

## INTRODUCTION

715 This part of IEC 61784 provides additional Communication Profiles (CP) to the existing  
716 Communication Profile Families (CPF) of IEC 61784-1 and additional CPFs with one or more  
717 CPs. These profiles meet the industrial automation market objective of identifying Real-Time  
718 Ethernet (RTE) communication networks coexisting with ISO/IEC 8802-3 or IEEE 802.3 –  
719 commonly known as Ethernet. These RTE communication networks use provision from  
720 ISO/IEC 8802-3 for the lower communication stack layers and additionally provide more  
721 predictable and reliable real-time data transfer and means for support of precise  
722 synchronization of automation equipment.

723 More specifically, these profiles help to correctly state the compliance of RTE communication  
724 networks with ISO/IEC 8802-3 or IEEE 802.3, and to avoid the spreading of divergent  
725 implementations.

726 Adoption of Ethernet technology for industrial communication between controllers and even  
727 for communication with field devices promotes use of Internet technologies in the field area.  
728 This availability would be unacceptable if it causes the loss of features required in the field  
729 area for industrial communication automation networks, such as:

- 730 • real-time,
- 731 • synchronized actions between field devices like drives,
- 732 • efficient, frequent exchange of very small data records.

733 These new RTE profiles may take advantage of the improvements of Ethernet networks in  
734 terms of transmission bandwidth and network span.

735 Another implicit but essential requirement is that the typical Ethernet communication  
736 capabilities, as used in the office world, are fully retained, so that the software involved  
737 remains applicable.

738 The market is in need of several network solutions, each with different performance  
739 characteristics and functional capabilities, matching the diverse application requirements.  
740 RTE performance indicators (see Clause 5), which values will be provided with RTE devices  
741 based on communication profiles specified in this part of IEC 61784, enable the user to match  
742 network devices with application dependant performance requirements of an RTE network.

743 Subclause 5.1 specifies basic principles of performance indicators required to express RTE  
744 performance of a CP. Subclause 5.2 describes the view of application requirements. An  
745 application-dependant class could be used to find out a suitable CP. Clause 4 specifies how  
746 conformance of a device to the CPF or CP should be stated.

747

## INDUSTRIAL COMMUNICATION NETWORKS – PROFILES –

### Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3

#### 1 Scope

This part of IEC 61784 specifies

- performance indicators supporting classification schemes for Real-Time Ethernet (RTE) requirements;
- profiles and related network components based on ISO/IEC 8802-3 or IEEE 802.3, IEC 61158 series, and IEC 61784-1;
- RTE solutions that are able to run in parallel with ISO/IEC 8802-3 or IEEE 802.3 based applications.

These communication profiles are called Real-Time Ethernet communication profiles.

NOTE The RTE communication profiles use ISO/IEC 8802-3 or IEEE 802.3 communication networks and its related network components or IEC 61588 and may in some cases amend those standards to obtain RTE features.

#### 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 61010 (all parts), *Safety requirements for electrical equipment for measurement, control, and laboratory use*

IEC 61131-2, *Programmable controllers – Part 2: Equipment requirements and tests*

IEC 61158 (all parts), *Industrial communication networks – Fieldbus specifications*

Year “:201X” indicates that for this part of IEC 61158 a new edition is planned for 2018. It is planned, that the CDV of these parts will be distributed concurrently with IEC 61784-2 (this document). An appropriate footnote will be inserted before the CDV is distributed.

IEC 61158-1:201X, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-2:2014, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-3-2:201X, *Industrial communication networks – Fieldbus specifications – Part 3-2: Data-link layer service definition – Type 2 elements*

- 789 IEC 61158-3-4:201X, *Industrial communication networks – Fieldbus specifications – Part 3-4:*  
790 *Data-link layer service definition – Type 4 elements*
- 791 IEC 61158-3-11:2007, *Industrial communication networks – Fieldbus specifications –*  
792 *Part 3-11: Data-link layer service definition – Type 11 elements*
- 793 IEC 61158-3-12:201X, *Industrial communication networks – Fieldbus specifications –*  
794 *Part 3-12: Data-link layer service definition – Type 12 elements*
- 795 IEC 61158-3-13:2014, *Industrial communication networks – Fieldbus specifications –*  
796 *Part 3-13: Data-link layer service definition – Type 13 elements*
- 797 IEC 61158-3-14:2014, *Industrial communication networks – Fieldbus specifications –*  
798 *Part 3-14: Data-link layer service definition – Type 14 elements*
- 799 IEC 61158-3-17:2007, *Industrial communication networks – Fieldbus specifications –*  
800 *Part 3-17: Data-link layer service definition – Type 17 elements*
- 801 IEC 61158-3-19:201X, *Industrial communication networks – Fieldbus specifications –*  
802 *Part 3-19: Data-link layer service definition – Type 19 elements*
- 803 IEC 61158-3-21:201X, *Industrial communication networks – Fieldbus specifications –*  
804 *Part 3-21: Data-link layer service definition – Type 21 elements*
- 805 IEC 61158-3-22:201X, *Industrial communication networks – Fieldbus specifications –*  
806 *Part 3-22: Data-link layer service definition – Type 22 elements*
- 807 IEC 61158-3-25:201X, *Industrial communication networks – Fieldbus specifications –*  
808 *Part 3-25: Data-link layer service definition – Type 25 elements*
- 809 IEC 61158-4-2:201X, *Industrial communication networks – Fieldbus specifications – Part 4-2:*  
810 *Data-link layer protocol specification – Type 2 elements*
- 811 IEC 61158-4-4:201X, *Industrial communication networks – Fieldbus specifications – Part 4-4:*  
812 *Data-link layer protocol specification – Type 4 elements*
- 813 IEC 61158-4-11:2014, *Industrial communication networks – Fieldbus specifications –*  
814 *Part 4-11: Data-link layer protocol specification – Type 11 elements*
- 815 IEC 61158-4-12:201X, *Industrial communication networks – Fieldbus specifications –*  
816 *Part 4-12: Data-link layer protocol specification – Type 12 elements*
- 817 IEC 61158-4-13:2014, *Industrial communication networks – Fieldbus specifications –*  
818 *Part 4-13: Data-link layer protocol specification – Type 13 elements*
- 819 IEC 61158-4-14:2014, *Industrial communication networks – Fieldbus specifications –*  
820 *Part 4-14: Data-link layer protocol specification – Type 14 elements*
- 821 IEC 61158-4-17:2007, *Industrial communication networks – Fieldbus specifications –*  
822 *Part 4-17: Data-link layer protocol specification – Type 17 elements*
- 823 IEC 61158-4-19:201X, *Industrial communication networks – Fieldbus specifications –*  
824 *Part 4-19: Data-link layer protocol specification – Type 19 elements*
- 825 IEC 61158-4-21:201X, *Industrial communication networks – Fieldbus specifications –*  
826 *Part 4-21: Data-link layer protocol specification – Type 21 elements*

- 827 IEC 61158-4-22:201X, *Industrial communication networks – Fieldbus specifications –*  
828 *Part 4-22: Data-link layer protocol specification – Type 22 elements*
- 829 IEC 61158-4-25:201X, *Industrial communication networks – Fieldbus specifications –*  
830 *Part 4-25: Data-link layer protocol specification – Type 25 elements*
- 831 IEC 61158-5-2:201X, *Industrial communication networks – Fieldbus specifications – Part 5-2:*  
832 *Application layer service definition – Type 2 elements*
- 833 IEC 61158-5-4:201X, *Industrial communication networks – Fieldbus specifications – Part 5-4:*  
834 *Application layer service definition – Type 4 elements*
- 835 IEC 61158-5-10:201X, *Industrial communication networks – Fieldbus specifications –*  
836 *Part 5-10: Application layer service definition – Type 10 elements*
- 837 IEC 61158-5-11:2007, *Industrial communication networks – Fieldbus specifications –*  
838 *Part 5-11: Application layer service definition – Type 11 elements*
- 839 IEC 61158-5-12:201X, *Industrial communication networks – Fieldbus specifications –*  
840 *Part 5-12: Application layer service definition – Type 12 elements*
- 841 IEC 61158-5-13:2014, *Industrial communication networks – Fieldbus specifications –*  
842 *Part 5-13: Application layer service definition – Type 13 elements*
- 843 IEC 61158-5-14:2014, *Industrial communication networks – Fieldbus specifications –*  
844 *Part 5-14: Application layer service definition – Type 14 elements*
- 845 IEC 61158-5-15:2010, *Industrial communication networks – Fieldbus specifications –*  
846 *Part 5-15: Application layer service definition – Type 15 elements*
- 847 IEC 61158-5-17:2007, *Industrial communication networks – Fieldbus specifications –*  
848 *Part 5-17: Application layer service definition – Type 17 elements*
- 849 IEC 61158-5-19:201X, *Industrial communication networks – Fieldbus specifications –*  
850 *Part 5-19: Application layer service definition – Type 19 elements*
- 851 IEC 61158-5-21:201X, *Industrial communication networks – Fieldbus specifications –*  
852 *Part 5-21: Application layer service definition – Type 21 elements*
- 853 IEC 61158-5-22:2014, *Industrial communication networks – Fieldbus specifications –*  
854 *Part 5-22: Application layer service definition – Type 22 elements*
- 855 IEC 61158-5-23:201X, *Industrial communication networks – Fieldbus specifications –*  
856 *Part 5-23: Application layer service definition – Type 23 elements*
- 857 IEC 61158-5-25:201X, *Industrial communication networks – Fieldbus specifications –*  
858 *Part 5-25: Application layer service definition – Type 25 elements*
- 859 IEC 61158-5-26:201X, *Industrial communication networks – Fieldbus specifications –*  
860 *Part 5-26: Application layer service definition – Type 26 elements*
- 861 IEC 61158-6-2:201X, *Industrial communication networks – Fieldbus specifications – Part 6-2:*  
862 *Application layer protocol specification – Type 2 elements*
- 863 IEC 61158-6-4:201X, *Industrial communication networks – Fieldbus specifications – Part 6-4:*  
864 *Application layer protocol specification – Type 4 elements*

- 865 IEC 61158-6-10:201X, *Industrial communication networks – Fieldbus specifications –*  
866 *Part 6-10: Application layer protocol specification – Type 10 elements*
- 867 IEC 61158-6-11:2007, *Industrial communication networks – Fieldbus specifications –*  
868 *Part 6-11: Application layer protocol specification – Type 11 elements*
- 869 IEC 61158-6-12:201X, *Industrial communication networks – Fieldbus specifications –*  
870 *Part 6-12: Application layer protocol specification – Type 12 elements*
- 871 IEC 61158-6-13:2014, *Industrial communication networks – Fieldbus specifications –*  
872 *Part 6-13: Application layer protocol specification – Type 13 elements*
- 873 IEC 61158-6-14:2014, *Industrial communication networks – Fieldbus specifications –*  
874 *Part 6-14: Application layer protocol specification – Type 14 elements*
- 875 IEC 61158-6-15:2010, *Industrial communication networks – Fieldbus specifications –*  
876 *Part 6-15: Application layer protocol specification – Type 15 elements*
- 877 IEC 61158-6-17:2007, *Industrial communication networks – Fieldbus specifications –*  
878 *Part 6-17: Application layer protocol specification – Type 17 elements*
- 879 IEC 61158-6-19:201X, *Industrial communication networks – Fieldbus specifications –*  
880 *Part 6-19: Application layer protocol specification – Type 19 elements*
- 881 IEC 61158-6-21:201X, *Industrial communication networks – Fieldbus specifications –*  
882 *Part 6-21: Application layer protocol specification – Type 21 elements*
- 883 IEC 61158-6-22:2014, *Industrial communication networks – Fieldbus specifications –*  
884 *Part 6-22: Application layer protocol specification – Type 22 elements*
- 885 IEC 61158-6-23:201X, *Industrial communication networks – Fieldbus specifications –*  
886 *Part 6-23: Application layer protocol specification – Type 23 elements*
- 887 IEC 61158-6-25:201X, *Industrial communication networks – Fieldbus specifications –*  
888 *Part 6-25: Application layer protocol specification – Type 25 elements*
- 889 IEC 61158-6-26:201X, *Industrial communication networks – Fieldbus specifications –*  
890 *Part 6-26: Application layer protocol specification – Type 26 elements*
- 891 IEC 61588:2009, *Precision clock synchronization protocol for networked measurement and*  
892 *control systems*
- 893 IEC 61784-1:201X, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*
- 894 IEC 61784-3-3:2016, *Industrial communication networks – Profiles – Part 3-3: Functional*  
895 *safety fieldbuses – Additional specifications for CPF 3*
- 896 **For IEC 61784-5-2, IEC 61784-5-3 and IEC 61784-5-6 an amendment or a new edition is**  
897 **planned. The references will be updated accordingly before the FDIS is distributed.**
- 898 IEC 61784-5-2:2013, *Industrial communication networks – Profiles – Part 5-2: Installation of*  
899 *fieldbuses – Installation profiles for CPF 2*
- 900 IEC 61784-5-3:2013, *Industrial communication networks – Profiles – Part 5-3: Installation of*  
901 *fieldbuses – Installation profiles for CPF 3*

- 902 IEC 61784-5-6:2013, *Industrial communication networks – Profiles – Part 5-6: Installation of*  
903 *fieldbuses – Installation profiles for CPF 6*
- 904 IEC 61784-5-8:2013, *Industrial communication networks – Profiles – Part 5-8: Installation of*  
905 *fieldbuses – Installation profiles for CPF 8*
- 906 IEC 61784-5-11:2013, *Industrial communication networks – Profiles – Part 5-11: Installation of*  
907 *fieldbuses – Installation profiles for CPF 11*
- 908 IEC 61784-5-20:201X, *Industrial communication networks – Profiles – Part 5-20: Installation*  
909 *of fieldbuses – Installation profiles for CPF 20*
- 910 IEC 61784-5-21:201X, *Industrial communication networks – Profiles – Part 5-21: Installation*  
911 *of fieldbuses – Installation profiles for CPF 21*
- 912 IEC 61918:201X, *Industrial communication networks – Installation of communication networks*  
913 *in industrial premises*
- 914 IEC 61800 (all parts), *Adjustable speed electrical power drive systems*
- 915 IEC 62439-2, *Industrial communication networks – High availability automation networks –*  
916 *Part 2: Media Redundancy Protocol (MRP)*
- 917 ISO/IEC 2382-16:1996, *Information technology – Vocabulary – Part 16: Information theory*
- 918 ISO/IEC 7498-1, *Information technology – Open Systems Interconnection –*  
919 *Basic Reference Model: The Basic Model*
- 920 ISO/IEC 8802-2, *Information technology – Telecommunications and information exchange*  
921 *between systems – Local and metropolitan area networks – Specific requirements – Part 2:*  
922 *Logical link control*  
923 *Corrigendum 1*
- 924 ISO/IEC 8802-3:2000, *Information technology – Telecommunications and information*  
925 *exchange between systems – Local and metropolitan area networks – Specific requirements –*  
926 *Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and*  
927 *physical layer specifications*
- 928 ISO/IEC 8802-11, *Information technology – Telecommunications and information exchange*  
929 *between systems – Local and metropolitan area networks – Specific requirements – Part 11:*  
930 *Wireless LAN medium access control (MAC) and physical layer (PHY) specifications*
- 931 ISO/IEC 9834-8, *Information technology – Procedures for the operation of object identifier*  
932 *registration authorities – Part 8: Generation of universally unique identifiers (UUIDs) and their*  
933 *use in object identifiers*
- 934 ISO/IEC 11801:2002, *Information technology – Generic cabling for customer premises*<sup>1</sup>  
935 *Amendment 1: 2008*  
936 *Amendment 2:2010*

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<sup>1</sup> There exists a consolidated edition 2.2:2011 that comprises ISO/IEC 11801:2002, its Amendment 1:2008 and its Amendment 2:2010.

- 937 ISO 15745-3, *Industrial automation systems and integration – Open systems application*  
938 *integration framework – Part 3: Reference description for IEC 61158-based control systems*
- 939 ISO 15745-4:2003, *Industrial automation systems and integration – Open systems application*  
940 *integration framework – Part 4: Reference description for Ethernet-based control systems*  
941
- 942 Amendment 1:2006, *PROFINET profiles*
- 943 IEEE 802-2001, *IEEE Standard for Local and Metropolitan Area Networks: Overview and*  
944 *Architecture*
- 945 IEEE 802.1AB, *IEEE Standard for Local and metropolitan area networks Station and Media*  
946 *Access Control Connectivity Discovery*
- 947 IEEE 802.1AS, *IEEE Standard for Information technology – Telecommunications and*  
948 *information exchange between systems – IEEE standard for Local and metropolitan area*  
949 *networks – Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area*  
950 *Networks*
- 951 IEEE 802.1D-2004, *IEEE Standard for Information technology – Telecommunications and*  
952 *information exchange between systems – IEEE standard for local and metropolitan area*  
953 *networks – Common specifications – Media access control (MAC) Bridges*
- 954 IEEE 802.1Q *IEEE Standard for Information technology – Telecommunications and*  
955 *information exchange between systems – IEEE standard for Local and metropolitan area*  
956 *networks – Virtual bridged local area networks*
- 957 IEEE 802.3, *IEEE Standard for Information technology – Telecommunications and information*  
958 *exchange between systems – Local and metropolitan area networks – Specific requirements –*  
959 *Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method*  
960 *and Physical Layer Specifications*
- 961 NOTE Generally the newest edition of IEEE 802.3 applies. Some Profiles reference the IEEE 802.3-2008 edition,  
962 in this case a dated reference is given.
- 963 IEEE Std 802.11, *IEEE Standard for Information technology – Telecommunications and*  
964 *information exchange between systems – Local and metropolitan area networks– Specific*  
965 *requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer*  
966 *(PHY) Specifications*
- 967 IEEE Std 802.15.1, *IEEE Standard for Information technology – Telecommunications and*  
968 *information exchange between systems – Local and metropolitan area networks – Specific*  
969 *requirements – Part 15: Wireless medium access control (MAC) and physical layer (PHY)*  
970 *specifications for wireless personal area networks (WPANs)*
- 971 IETF RFC 768, *User Datagram Protocol*, available at <<http://www.ietf.org>>
- 972 IETF RFC 791, *Internet Protocol*, available at <<http://www.ietf.org>>
- 973 IETF RFC 792, *Internet Control Message Protocol*, available at <<http://www.ietf.org>>
- 974 IETF RFC 793, *Transmission Control Protocol*, available at <<http://www.ietf.org>>
- 975 IETF RFC 826, *Ethernet Address Resolution Protocol*, available at <<http://www.ietf.org>>
- 976 IETF RFC 894, *A standard for the Transmission of IP Datagrams over Ethernet Networks*,  
977 available at <<http://www.ietf.org>>

- 978 IETF RFC 919, *Broadcasting Internet Datagrams*, available at <<http://www.ietf.org>>
- 979 IETF RFC 922, *Broadcasting Internet datagrams in the presence of subnets*, available at  
980 <<http://www.ietf.org>>
- 981 IETF RFC 950, *Internet Standard Subnetting Procedure*, available at <<http://www.ietf.org>>
- 982 IETF RFC 1034, *Domain names – concepts and facilities*; available at <<http://www.ietf.org>>
- 983 IETF RFC 1112, *Host Extensions for IP Multicasting*, available at <<http://www.ietf.org>>
- 984 IETF RFC 1122, *Requirements for Internet Hosts – Communication Layers*, available at  
985 <<http://www.ietf.org>>
- 986 IETF RFC 1123, *Requirements for Internet Hosts – Application and Support*, available at  
987 <<http://www.ietf.org>>
- 988 IETF RFC 1127, *A Perspective on the Host Requirements RFCs*, available at  
989 <<http://www.ietf.org>>
- 990 IETF RFC 1157, *Simple Network Management Protocol (SNMP)*, available at  
991 <<http://www.ietf.org>>
- 992 IETF RFC 1213, *Management Information Base for Network Management of TCP/IP-based*  
993 *internets: MIB-II*, available at <<http://www.ietf.org>>
- 994 IETF RFC 1305, *Network Time Protocol (Version 3)*, available at <<http://www.ietf.org>>
- 995 IETF RFC 2131, *Dynamic Host Configuration Protocol*, available at <<http://www.ietf.org>>
- 996 IETF RFC 2236, *Internet Group Management Protocol, Version 2*, available at  
997 <<http://www.ietf.org>>
- 998 IETF RFC 2544, *Benchmarking Methodology for Network Interconnect Devices*, available at  
999 <<http://www.ietf.org>>
- 1000 IETF RFC 2988, *Computing TCP's Retransmission Timer*, available at <<http://www.ietf.org>>
- 1001 IETF RFC 4836, *Definitions of Managed Objects for IEEE 802.3 Medium*  
1002 *Attachment Units (MAUs)*, available at <<http://www.ietf.org>>
- 1003 The Open Group – Publication C706, *Technical standard DCE1.1: Remote Procedure Call*,  
1004 available at <<http://www.opengroup.org/onlinepubs/9629399/toc.htm>>

### 1005 **3 Terms, definitions, abbreviated terms, acronyms, and conventions**

#### 1006 **3.1 Terms and definitions**

1007 For the purposes of this document, the terms and definitions given in ISO/IEC 8802-3,  
1008 IEEE 802, IEEE 802.1AB, IEEE 802.1AS, IEEE 802.1D, IEEE 802.1Q and IEEE 802.3, as well  
1009 as the following, apply.

1010 **3.1.1**  
1011 **active network**  
1012 network in which data transmission between non-immediately-connected devices is  
1013 dependent on active elements within those intervening devices that form the connection path

1014 [SOURCE: IEC 61918:201X, 3.1.3]

1015 **3.1.2**  
1016 **communication cycle**  
1017 <CPF 16>  
1018 fixed time period between two master synchronization telegrams

1019 **3.1.3**  
1020 **cyclic**  
1021 repetitive in a regular manner

1022 **3.1.4**  
1023 **domain**  
1024 <CPF 10>  
1025 part of the network consisting of one or two subnetwork(s)

1026 Note 1 to entry: Two subnetworks are required to compose a dual-redundant network, and each end-station in the  
1027 domain is connected to both of the subnetworks.

1028 **3.1.5**  
1029 **end-station**  
1030 a system attached to a network that is an initial source or a final destination of MAC frames  
1031 transmitted across that network

1032 Note 1 to entry: A network layer router is, from the perspective of the network, an end-station. A switch, in its role  
1033 of forwarding MAC frames from one link to another, is not an end-station.

1034 **3.1.6**  
1035 **field area**  
1036 place in a manufacturing or process site where field devices are located

1037 **3.1.7**  
1038 **frame**  
1039 a unit of data transmission on an ISO/IEC 8802-3 MAC (Media Access Control) that conveys a  
1040 protocol data unit (PDU) between MAC service users

1041 [SOURCE: IEEE 802.1Q]

1042 **3.1.8**  
1043 **identification number**  
1044 **IDN**  
1045 <CPF 16>  
1046 designation of operating data under which a data block is preserved with its attribute, name,  
1047 unit, minimum and maximum input values, and the data

1048 **3.1.9**  
1049 **IP channel**  
1050 <CPF 16>  
1051 defined time slot within the communication cycle, which passes ISO/IEC 8802-3 Ethernet  
1052 protocol frames (non-real-time communication)

1053 **3.1.10**  
1054 **jitter**  
1055 temporal change in clock signal or temporal change in otherwise regular event

1056 **3.1.11**  
1057 **linear topology**  
1058 topology where the nodes are connected in series, with two nodes each connected to only  
1059 one other node and all others each connected to two other nodes (that is, connected in the  
1060 shape of a line)

1061 [SOURCE: IEC 61918:201X, 3.1.44]

1062 **3.1.12**  
1063 **link**  
1064 transmission path between two adjacent nodes

1065 [SOURCE: derived from ISO/IEC 11801]

1066 **3.1.13**  
1067 **logical double line**  
1068 <CPF 18>  
1069 sequence of root device and all ordinary devices processing the DLPDU in forward and  
1070 backward direction

1071 **3.1.14**  
1072 **master**  
1073 <CPF 16>  
1074 node which assigns the other nodes the right to transmit

1075 **3.1.15**  
1076 **message**  
1077 ordered series of octets intended to convey information

1078 [SOURCE: derived from ISO/IEC 2382-16:1996, 16.02.01]

1079 Note 1 to entry: Normally used to convey information between peers at the application layer.

1080 **3.1.16**  
1081 **MDT0 telegram**  
1082 <CPF 16>  
1083 telegram, in which the master transmits its synchronization data, as well as parts or all of its  
1084 real-time data, to the slaves

1085 **3.1.17**  
1086 **node**  
1087 network entity connected to one or more links

1088 Note 1 to entry: A node may be either a switch, an end-station or an RTE end-station.

1089 **3.1.18**  
1090 **packet**  
1091 logical grouping of information used to describe a unit of data at any layer to convey the  
1092 upper layer user data to its peer layer

1093 Note 1 to entry: A packet is identical to the PDU at each layer in terms of the OSI reference model. A data-link  
1094 layer packet is a frame.

1095 **3.1.19**  
1096 **real-time**  
1097 the ability of a system to provide a required result in a bounded time

1098 **3.1.20**  
1099 **real-time communication**  
1100 transfer of data in real time

1101 **3.1.21**  
1102 **Real-Time Ethernet**  
1103 **RTE**  
1104 ISO/IEC 8802-3 or IEEE 802.3 based network that includes real-time communication

1105 Note 1 to entry: Other communication can be supported, providing the real-time communication is not  
1106 compromised.

1107 Note 2 to entry: This definition is dedicated but not limited to ISO/IEC 8802-3. It could be applicable to other  
1108 IEEE 802 specifications, for example IEEE 802.11.

1109 **3.1.22**  
1110 **real time frame line**  
1111 **RTFL**  
1112 <CPF 18>  
1113 communication model with devices communicating in a logical double line

1114 **3.1.23**  
1115 **real time frame network**  
1116 **RTFN**  
1117 <CPF 18>  
1118 communication model with devices communicating in a switched network

1119 **3.1.24**  
1120 **ring**  
1121 active network where each node is connected in series to two other nodes

1122 Note 1 to entry: Ring may also be referred to as loop.

1123 [SOURCE: IEC 61918:201X, 3.1.63]

1124 **3.1.25**  
1125 **router**  
1126 <CPF 10>  
1127 intermediate equipment that connects two or more subnetworks using a network layer relay  
1128 function

1129 **3.1.26**  
1130 **RTE end device**  
1131 device with at least one RTE end-station

1132 **3.1.27**  
1133 **RTE end-station**  
1134 end-station with RTE capability

1135 **3.1.28**  
1136 **schedule**  
1137 temporal arrangement of a number of related operations

1138 **3.1.29**  
1139 **star**  
1140 network of three or more devices where all devices are connected to a central point

1141 [SOURCE: IEC 61918:201X, 3.1.69, modified – "which may be active or passive" has been  
1142 suppressed]

1143 **3.1.30**  
1144 **subnetwork**  
1145 <CPF 10>  
1146 part of a network that does not contain any routers

1147 Note 1 to entry: A subnetwork consists of end-stations, bridges and segments.

1148 Note 2 to entry: Every end-station included in a subnetwork has the same IP network address.

1149 **3.1.31**  
1150 **switch**  
1151 MAC bridge as defined in IEEE 802.1Q

1152 **3.1.32**  
1153 **telegram**  
1154 <CPF 16>  
1155 frame

1156 **3.2 Abbreviated terms and acronyms**

|         |                                                                 |
|---------|-----------------------------------------------------------------|
| AL      | Application Layer                                               |
| APDU    | Application Protocol Data Unit                                  |
| API     | Application Process Identifier                                  |
| AR      | Application Relationship                                        |
| ARP     | Address Resolution Protocol                                     |
| ASE     | Application Service Element                                     |
| CP      | Communication Profile [according to IEC 61784-1]                |
| CPF     | Communication Profile Family [according to IEC 61784-1]         |
| CRC     | Cyclic Redundancy Check                                         |
| CSMA-CD | Carrier Sense Multiple Access with Collision Detection          |
| DA      | Destination MAC Address                                         |
| DCP     | Discovery and basic Configuration Protocol (see IEC 61158-6-10) |
| DHCP    | Dynamic Host Configuration Protocol (see IETF RFC 2131)         |
| DL      | Data-Link layer (as a prefix)                                   |
| DLL     | DL-Layer                                                        |
| DNS     | Domain Name Service (see IETF RFC 1034)                         |
| DUT     | Device under test                                               |
| ECSME   | EPA Communication Scheduling Management Entity                  |
| FA      | Factory Automation                                              |
| FCS     | Frame check sequence                                            |
| FrameID | Frame Identifier (see IEC 61158-6-10)                           |
| GSD     | General station description                                     |
| HW      | Hardware                                                        |
| IANA    | Internet Assigned Numbers Authority                             |
| ICMP    | Internet Control Message Protocol (see IETF RFC 792)            |
| ID      | Identifier                                                      |
| IDN     | IDentification Number                                           |
| IETF    | Internet Engineering Task Force                                 |
| IO      | Input Output                                                    |

|             |                                                                                                |
|-------------|------------------------------------------------------------------------------------------------|
| IP          | Internet Protocol (see IETF RFC 791)                                                           |
| IPv4        | Internet Protocol version 4 (see IETF RFC 791)                                                 |
| IRT         | Isochronous RT                                                                                 |
| LAN         | Local Area Network                                                                             |
| LLC         | Logical Link Control                                                                           |
| LLDP        | Link Layer Discovery Protocol (see IEEE 802.1AB)                                               |
| MAC         | Media Access Control                                                                           |
| MAC         | Media Access Control (see ISO/IEC 8802.3 or IEEE 802.3)                                        |
| Mbit/s      | Million bits per second                                                                        |
| Moctets/s   | Million octets per second                                                                      |
| MCR         | Multicast communication relation                                                               |
| MIB         | Management Information base                                                                    |
| MRP         | Medium redundancy protocol (see IEC 62439-2)                                                   |
| MRPD        | Media redundancy for planned duplication                                                       |
| ms          | milli seconds                                                                                  |
| n.a.        | Not applicable                                                                                 |
| NoS         | Number of Switches                                                                             |
| NRT         | Non-real-time                                                                                  |
| PDU         | Protocol Data Unit                                                                             |
| PI          | Performance indicator                                                                          |
| ns          | nano seconds                                                                                   |
| OID         | Object Identifier (see IETF RFC 1157)                                                          |
| PDU         | Protocol Data Unit                                                                             |
| PhL         | Physical Layer                                                                                 |
| Phy         | PHY Physical layer entity sublayer (see ISO/IEC 8802.3 or IEEE 802.3)                          |
| PI          | Performance indicator                                                                          |
| pps         | Packets per second                                                                             |
| PTCP        | Precision Transparent Clock Protocol                                                           |
| PTP         | Precision Time Protocol [IEC 61588]                                                            |
| RPC         | Remote Procedure Call (see The Open Group – Publication C706)                                  |
| RSTP        | Rapid Spanning Tree Algorithm and Protocol (see IEEE 802.1Q)                                   |
| RT          | Real-time                                                                                      |
| RTA         | Real-time protocol acyclic                                                                     |
| RTE         | Real-time Ethernet                                                                             |
| RT-Ethernet | Real-time Ethernet                                                                             |
| RTFL        | Real time frame line                                                                           |
| RTFN        | Real time frame network                                                                        |
| RTO         | Retransmission Time Out<br>[according to IETF RFC 2988 – Computing TCP's Retransmission Timer] |
| RTPS        | Real-Time Publish-Subscribe                                                                    |
| SERCOS      | SERial Real time COmmunication System                                                          |
| SNMP        | Simple Network Management Protocol (see IETF RFC 1157)                                         |
| TCC         | Time-Critical Cyclic                                                                           |

|      |                                                  |
|------|--------------------------------------------------|
| TCP  | Transmission Control Protocol (see IETF RFC 793) |
| TOS  | Type of Service                                  |
| UDP  | User Datagram Protocol (see IETF RFC 768)        |
| VLAN | Virtual LAN                                      |

### 1157 3.3 Symbols

#### 1158 3.3.1 CPF 2 symbols

| Symbol                | Definition                                                       | Unit   |
|-----------------------|------------------------------------------------------------------|--------|
| APDUsize              | Size of the application protocol data unit per CP 2/2 connection | octets |
| CD                    | Cable segment delay                                              | µs     |
| CL                    | Cable segment length                                             | m      |
| DT                    | Delivery time                                                    | µs     |
| EN_N RTE_PR           | End-station non-RTE packet rate per CP 2/2 connection            | pps    |
| EN_RTE_PR             | End-station RTE packet rate per CP 2/2 connection                | pps    |
| EN_PR                 | End-station packet rate                                          | pps    |
| EN_PR_MAX             | End-station maximum packet rate                                  | pps    |
| EN_TNRTE_PR           | End-station total non-RTE packet rate in pps                     | pps    |
| EN_TRTE_PR            | End-station total RTE packet rate                                | pps    |
| k                     | Number of CP 2/2 connections supported by the end-station        | –      |
| m                     | Number of CR 2/2 non-RTE connections                             | –      |
| n                     | Number of switches between sending and receiving end-stations    | –      |
| p                     | Number of CR 2/2 RTE connections                                 | –      |
| N RTE_BW              | Non-RTE bandwidth                                                | %      |
| PD                    | Cable propagation delay                                          | n/m    |
| SD <sub>r</sub>       | Receiver stack delay                                             | µs     |
| SD <sub>s</sub>       | Sender stack delay                                               | µs     |
| SL                    | Switch latency                                                   | µs     |
| SPD                   | Switch processing delay                                          | µs     |
| T <sub>x_packet</sub> | Packet transmit time                                             | µs     |

1159

1160 **3.3.2 CPF 3 symbols**

| Symbol                 | Definition                                                 | Unit     |
|------------------------|------------------------------------------------------------|----------|
| Cd                     | Cable delay (see attribute cable_delay in IEC 61158–5–10)  | s        |
| Cl <sub>t</sub>        | Total cable length                                         | m        |
| cta <sub>R</sub>       | Application cycle time of the Receiver                     | s        |
| cta <sub>S</sub>       | Application cycle time of the Sender                       | s        |
| Ctc                    | Communication cycle time                                   | s        |
| Ctc                    | Communication cycle time                                   | s        |
| Data                   | Complete Ethernet frame                                    | octets   |
| data_request           | Requested RTE throughput                                   | octets/s |
| data_RTE               | Actual RTE throughput                                      | octets/s |
| DT                     | Delivery time                                              | s        |
| endStations            | Number of end-stations                                     | —        |
| EthernetDataRate       | Ethernet data rate of the network                          | Mbit/s   |
| MAC_delay              | Delay on MAC layer                                         | s        |
| NonRTE                 | Percentage of non-RTE bandwidth                            | %        |
| NoS                    | Number of switches                                         | —        |
| Od                     | Other delays, e. g. signal forwarding in a ring            | s        |
| Pd                     | Propagation delay                                          | s        |
| Phy_R_delay            | PHY delay on receiver side                                 | s        |
| Phy_S_delay            | PHY delay on sender side                                   | s        |
| protocolRTE            | Percentage of protocol time                                | s        |
| Queue_delay            | Queue delay in a switch                                    | s        |
| RM                     | Time needed for management functions to support redundancy | s        |
| RR                     | Attribute <i>Reduction Ratio</i> (see IEC 61158–5–10)      | —        |
| SCF                    | Attribute <i>Send Clock Factor</i> (see IEC 61158–5–10)    | —        |
| STTr                   | Receiver stack traversal time including PHY and MAC        | s        |
| STTs                   | Sender stack traversal time including PHY and MAC          | s        |
| Throughput_RTE         | Throughput RTE                                             | octets/s |
| Time_synchron_accuracy | Time synchronization accuracy                              | s        |
| Tt                     | Transfer time                                              | s        |

1161

1162 **3.3.3 CPF 4 symbols**

| Symbol  | Definition                                                                                | Unit |
|---------|-------------------------------------------------------------------------------------------|------|
| cd      | Cable delay (Maximum on 100m)                                                             | µs   |
| DT      | Delivery time                                                                             | µs   |
| DTb     | Delivery time, calculated by best-case values                                             | µs   |
| DTw     | Delivery time, calculated by worst-case values                                            | µs   |
| FS      | Number of frames allowed to be sent per second for one RTE end-station                    | –    |
| NoAS    | Number of accesses allowed per device per second                                          | –    |
| NoCEN   | Number of RTE end-stations which can produce frames on the critical switch-to-switch link | –    |
| NoNs[x] | Number of RTE end-stations connected to switch number x                                   | –    |
| NoNt    | Number of RTE end-stations, in total                                                      | –    |
| NoS     | Number of switches in path from sender to receiver                                        | –    |
| pd      | Propagation delay within a switch. Required minimum value                                 | µs   |
| QTES    | Ethernet enforced quiet time on end-station to switch link                                | µs   |
| QTSS    | Ethernet enforced quiet time on switch-to-switch link                                     | µs   |
| STTr    | Receiver stack transversal time including Phy and MAC                                     | µs   |
| STTs    | Sender stack transversal time including Phy and MAC                                       | µs   |
| ttES    | P-NET transfer time RTE end-station to switch (at maximum APDU size)                      | µs   |
| ttESmin | P-NET transfer time RTE end-station to switch (at min APDU size)                          | µs   |
| ttSS    | P-NET transfer time switch-to-switch (at maximum APDU size)                               | µs   |

1163

1164 **3.3.4 CPF 6 symbols**

| Symbol           | Definition                                                              | Unit   |
|------------------|-------------------------------------------------------------------------|--------|
| DTLD             | Total delivery time between a Type 8 slave and a Type 10 entity         | µs     |
| DT10             | Delivery time of the Type 10 network                                    | µs     |
| Cta_M            | Application cycle time of the mapping application in the linking-device |        |
| M                | Type 8 Master implementation factor                                     | –      |
| n                | Number of data octets (user data; payload)                              | octets |
| sl8              | Number of Type 8 slaves connected to the linking-device                 | –      |
| T <sub>bit</sub> | Nominal bit duration (see 27.2 in IEC 61158-2)                          | µs     |
| t <sub>s</sub>   | Software processing time of the Type 8 master (application specific)    | µs     |

1165

1166 **3.3.5 CPF 10 symbols**

| Symbol  | Definition                                                                                                          | Unit   |
|---------|---------------------------------------------------------------------------------------------------------------------|--------|
| Cdly    | Cable delay                                                                                                         | µs     |
| Clen    | Cable length                                                                                                        | m      |
| Dlen    | Length of the complete Ethernet frame                                                                               | bit    |
| DT      | Delivery time                                                                                                       | µs     |
| DTlost1 | maximum delivery time with one lost frame for communication between two end-stations belonging to the same domain   | µs     |
| DTlost2 | maximum delivery time with one lost frame for communication between two end-stations belonging to different domains | µs     |
| DTmax1  | maximum delivery time for communication between two end-stations belonging to the same domain                       | µs     |
| DTmax2  | maximum delivery time for communication between two end-stations belonging to different domains                     | µs     |
| NoS     | Number of switches in path from sender to receiver                                                                  | —      |
| Spd     | Switch delay under not congested condition                                                                          | µs     |
| STTr    | Receiver stack transversal time including PhL, DLL and AP                                                           | µs     |
| STTs    | Sender stack transversal time including PhL, DLL and AP                                                             | µs     |
| Trate   | Transfer bit rate                                                                                                   | Mbit/s |

1167

1168 **3.3.6 CPF 11 symbols**

| Symbol            | Definition                                                                                                                                                                   | Unit   |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| BW <sub>CNT</sub> | Bandwidth used both for the communication scheduling and the protocol overhead                                                                                               | %      |
| BW <sub>NRT</sub> | Bandwidth used for the non-RTE communications                                                                                                                                | %      |
| BW <sub>RTE</sub> | Bandwidth used for the RTE communications                                                                                                                                    | %      |
| cd                | Cable delay                                                                                                                                                                  | µs     |
| cdl               | Cable length total                                                                                                                                                           | km     |
| ct                | Cycle time                                                                                                                                                                   | ms     |
| data              | Complete Ethernet frame                                                                                                                                                      | —      |
| DT <sub>H</sub>   | Delivery time of the high-speed cyclic data, which includes both the sender stack traversal time (STTs) and the receiver stack traversal time (STTr) including Phy and MAC   | ms     |
| DT <sub>L</sub>   | Delivery time of the low-speed cyclic data, which includes both the sender stack traversal time (STTs) and the receiver stack traversal time (STTr) including Phy and MAC    | ms     |
| DT <sub>M</sub>   | Delivery time of the medium-speed cyclic data, which includes both the sender stack traversal time (STTs) and the receiver stack traversal time (STTr) including Phy and MAC | ms     |
| DV <sub>HS</sub>  | Total volume of the high-speed cyclic data                                                                                                                                   | octets |
| DV <sub>LS</sub>  | Total volume of the low-speed cyclic data                                                                                                                                    | octets |
| DV <sub>MS</sub>  | Total volume of the medium-speed cyclic data                                                                                                                                 | octets |
| NoS               | Number of switches                                                                                                                                                           | —      |
| od                | Other delays                                                                                                                                                                 | µs     |
| pd                | Propagation delay                                                                                                                                                            | µs     |
| STTs              | Sender stack traversal time including Phy and MAC                                                                                                                            | µs     |
| STTr              | Receiver stack traversal time including Phy and MAC                                                                                                                          | µs     |

| Symbol     | Definition                                                                                                                                                                                                                       | Unit      |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| $T_h$      | The high-speed transmission time period – the basic cycle_time (ct) of the TCC data service                                                                                                                                      | ms        |
| $T_{HS}$   | Total sum of the frame transmit time, in which the TCC data frame conveys the high-speed cyclic data                                                                                                                             | $\mu$ s   |
| $T_l$      | The Low-speed transmission time period                                                                                                                                                                                           | ms        |
| $T_{LS}$   | Total sum of the frame transmit time, in which the TCC data frame conveys the Low-speed Cyclic data                                                                                                                              | $\mu$ s   |
| $T_m$      | The Medium-speed transmission time period                                                                                                                                                                                        | ms        |
| $T_{MAC}$  | Time for the maintenance and control, in which a new end-station is solicited to join and the periodic time operation is controlled                                                                                              | $\mu$ s   |
| $T_{MS}$   | Total sum of the frame transmit time, in which the TCC data frame conveys the medium-speed cyclic data                                                                                                                           | $\mu$ s   |
| $T_{NRT}$  | Total sum of the frame transmit time, in which the frame, with the non-RTE data as a payload, is sent out of the end-station within the time period of $T_h$ and is used for the standard Ethernet application on sporadic basis | $\mu$ s   |
| $TR_{HS}$  | Throughput RTE of the high-speed cyclic data                                                                                                                                                                                     | Moctets/s |
| $TR_{LS}$  | Throughput RTE of the low-speed cyclic data                                                                                                                                                                                      | Moctets/s |
| $TR_{MS}$  | Throughput RTE of the medium-speed cyclic data                                                                                                                                                                                   | Moctets/s |
| $TR_{RTE}$ | Throughput RTE, and the sum of $TR_{HS}$ , $TR_{LS}$ and $TR_{MS}$                                                                                                                                                               | Moctets/s |
| $T_{RTE}$  | Total sum of the frame transmit time, in which the frame, with the RTE data as a payload of a fixed length, is sent out of the end-station within the time period of $T_h$                                                       | $\mu$ s   |
| $T_{SCH}$  | Total sum of the frame transmit time for the transmission scheduling                                                                                                                                                             | $\mu$ s   |
| tt         | Transfer time                                                                                                                                                                                                                    | $\mu$ s   |

1169

### 1170 3.3.7 CPF 12 symbols

| Symbol      | Definition                                            | Unit      |
|-------------|-------------------------------------------------------|-----------|
| $l_{tc}$    | Total cable length                                    | m         |
| $NoS$       | Number of slaves                                      |           |
| $Pd$        | Propagation delay                                     | $\mu$ s   |
| $t_{cd}$    | Cable delay                                           | $\mu$ s/m |
| $t_{cpdl}$  | Data copy delay within a slave                        | $\mu$ s   |
| $t_{cycle}$ | Cycle time                                            | $\mu$ s   |
| $t_D$       | Delivery time                                         | $\mu$ s   |
| $t_{data}$  | Time to transmit the longest real-time Ethernet frame | $\mu$ s   |

1171

### 1172 3.3.8 CPF 13 symbols

| Symbol     | Definition                                                      | Unit    |
|------------|-----------------------------------------------------------------|---------|
| $B_{NRTE}$ | Non-RTE bandwidth                                               | %       |
| M          | Network MTU (maximum transmission unit)                         | octets  |
| N          | Number of RTE end-stations processed in one communication cycle | –       |
| $T_A$      | Time reserved for non-RTE data within one communication cycle   | $\mu$ s |
| $T_C$      | Communication cycle time                                        | $\mu$ s |
| $T_D$      | Delivery time                                                   |         |

| Symbol     | Definition                                                                                         | Unit          |
|------------|----------------------------------------------------------------------------------------------------|---------------|
| $T_{FT,i}$ | RTE frames transmission time for RTE end-station i                                                 | $\mu\text{s}$ |
| $T_{PR}$   | Processing time in the receiving end-station                                                       | $\mu\text{s}$ |
| $T_{PS}$   | Processing time in the sending end-station                                                         | $\mu\text{s}$ |
| $T_{RD,i}$ | Response delay of the RTE end-station i                                                            | $\mu\text{s}$ |
| $T_S$      | Communication cycle start delay                                                                    | $\mu\text{s}$ |
| $T_{SD,i}$ | Sum of all delays of infrastructure components (switches, hubs, cabling) for the RTE end-station i | $\mu\text{s}$ |

1173

### 1174 3.3.9 CPF 14 symbols

| Symbol            | Definition                                                        | Unit          |
|-------------------|-------------------------------------------------------------------|---------------|
| DT                | Delivery time                                                     | $\mu\text{s}$ |
| D_size            | Data size                                                         | octets        |
| LCable            | Cable length                                                      | m             |
| Ndata             | Length of complete Ethernet frame                                 | octets        |
| NRTE_BW           | Non-RTE bandwidth                                                 | %             |
| NSwitch           | Number of switches between end-stations                           |               |
| RateofEthernet    | Ethernet data rate                                                | Mbit/s        |
| RMDData           | Redundancy management data                                        | octets        |
| RTEDData          | Real-time data                                                    | octets        |
| TApp_R            | Receiver stack processing time including Phy and MAC              | $\mu\text{s}$ |
| TCable            | Cable delay                                                       | $\mu\text{s}$ |
| TD_Sw             | Time delay in switch                                              | $\mu\text{s}$ |
| TEthernet_S       | Sender traversal time through MAC and Phy based on ISO/IEC 8802-3 | $\mu\text{s}$ |
| ThroughputRT<br>E | RTE throughput                                                    | octets/s      |
| TQueue_S          | Sender queuing delay                                              | $\mu\text{s}$ |
| TSDData           | Time synchronization data                                         | octets        |
| TStack_S          | Sender stack processing time                                      | $\mu\text{s}$ |
| TSwitch           | Switch delay                                                      | $\mu\text{s}$ |
| TTrf_S            | Transfer time for one octet                                       | $\mu\text{s}$ |
| T_wire            | Time per octet on a wire segment                                  | $\mu\text{s}$ |
| STT_s             | Stack traversal time of the sender                                | $\mu\text{s}$ |
| STT_r             | Stack traversal time of the receiver                              | $\mu\text{s}$ |

1175

### 1176 3.3.10 CPF 15 symbols

| Symbol | Definition                                                                          | Unit          |
|--------|-------------------------------------------------------------------------------------|---------------|
| D_size | Data size                                                                           | octets        |
| DT     | Delivery time                                                                       | $\mu\text{s}$ |
| DT_If  | Delivery time when a frame is lost                                                  | $\mu\text{s}$ |
| DT_Ifh | Delivery time when a frame is lost and the configuration is reliable with heartbeat | $\mu\text{s}$ |
| DT_Ifp | Delivery time when a frame is lost and the configuration is reliable periodic       | $\mu\text{s}$ |
| DT_n   | Delivery time for the NACK message                                                  | $\mu\text{s}$ |

| Symbol | Definition                                                                       | Unit |
|--------|----------------------------------------------------------------------------------|------|
| H      | Period of the heartbeat, which is a configured parameter                         | µs   |
| N_Sw   | Number of switches between end-stations                                          | –    |
| RTO    | TCP retransmission time out parameter                                            | µs   |
| STT_r  | Stack traversal time of the receiver                                             | µs   |
| STT_r1 | Part of the stack traversal time of the receiver that is independent of D-size   | µs   |
| STT_r2 | Part of the stack traversal time of the receiver that depends linearly on D_size | µs   |
| STT_s  | Stack traversal time of the sender                                               | µs   |
| STT_s1 | Part of the stack traversal time of the sender that is independent of D_size     | µs   |
| STT_s2 | Part of the stack traversal time of the sender that depends linearly on D_size   | µs   |
| T      | Period, which is a configured parameter                                          | µs   |
| T_wire | Time per octet on a wire segment                                                 | µs   |
| TD_Sw  | Time delay in switch                                                             | µs   |

1177

### 1178 3.3.11 CPF 16 symbols

| Symbol | Definition                                                                  | Unit |
|--------|-----------------------------------------------------------------------------|------|
| ac     | Non-time based synchronization accuracy                                     | ns   |
| cd     | Cable delay                                                                 | µs/m |
| clt    | Total cable length                                                          | m    |
| ct     | Cycle_time configured for the network segment                               | µs   |
| data   | Data to be transmitted in one cycle (including the complete Ethernet frame) | bit  |
| DT     | Delivery time                                                               | µs   |
| fr     | Frame runtime                                                               | µs   |
| ma     | Synchronization accuracy of the master device                               | µs   |
| mct    | Minimum cycle time                                                          | ms   |
| N      | Integer value                                                               | –    |
| nf     | Number of frames                                                            | –    |
| nn     | Number of nodes                                                             | –    |
| pd     | Propagation delay (signal delay) of a forwarding node                       | µs   |
| sa     | Synchronization accuracy of one slave device                                | µs   |
| st     | Separation time per frame                                                   | µs   |
| tt     | Transfer time                                                               | µs   |

1179

### 1180 3.3.12 CPF 17 symbols

| Symbol                | Definition                                                                     | Unit   |
|-----------------------|--------------------------------------------------------------------------------|--------|
| APDUsize              | Size of the application protocol data unit in octets                           | octets |
| BW <sub>N RTE</sub>   | Non-RTE bandwidth, in %                                                        | %      |
| LDR                   | Link data rate in bit per seconds                                              | bps    |
| LTC                   | Total cable length in meter                                                    | m      |
| M                     | Number packets in the port transmit queue of node i in front on of this packet | –      |
| N                     | Number of nodes between sending and receiving end-stations                     | –      |
| NF <sub>E/S_MAX</sub> | Maximum number of frames allowed to be sent per second for one end station     | pps    |

| Symbol             | Definition                                                                                                                                          | Unit     |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| $N_{F_{RTE/S}}$    | Number of frames allowed to be sent per second for one RTE end station                                                                              | pps      |
| Posize             | Size of the protocol overhead in octets                                                                                                             | octets   |
| $T_{CPD}$          | Cable propagation delay time in microseconds                                                                                                        | $\mu s$  |
| $T_{CPD/M}$        | cable propagation delay in nanoseconds per meter (depending on the characteristics of the selected cable)                                           | ns/m     |
| $T_{DELAY}$        | Delivery time in microseconds                                                                                                                       | $\mu s$  |
| $T_{DELAY\_MAX}$   | Maximum delivery time in microseconds                                                                                                               | $\mu s$  |
| $T_{DELAY\_MIN}$   | Minimum delivery time in microseconds                                                                                                               | $\mu s$  |
| Throughput_RTE     | Throughput RTE                                                                                                                                      | octets/s |
| Throughput_RTE_MAX | Maximum throughput RTE                                                                                                                              | octets/s |
| $T_{NLD}$          | Node latency delay time in microseconds                                                                                                             | $\mu s$  |
| $T_{NLD\_i}$       | Node latency delay time of node i in microseconds                                                                                                   | $\mu s$  |
| $T_{NPD}$          | Node propagation delay time in microseconds                                                                                                         | $\mu s$  |
| $T_{NPD\_i}$       | Node propagation delay time of node i in microseconds                                                                                               | $\mu s$  |
| $T_{PKT}$          | Packet transmit time in microseconds                                                                                                                | $\mu s$  |
| $T_{PKT\_i}$       | Packet transmit time of node i in microseconds                                                                                                      | $\mu s$  |
| $T_{RCV}$          | Receiver stack traversal time including Phy and MAC in microseconds                                                                                 | $\mu s$  |
| $T_{SND}$          | Sender stack traversal time including Phy and MAC in microseconds                                                                                   | $\mu s$  |
| $T_{TX\_PKT\_ij}$  | packet transmit time of packet j in microseconds in the port transmit queue of node i in front on of this packet (depending on APDU size of node i) | $\mu s$  |
| $T_{TX\_PKT\_j}$   | packet transmit time of packet j in microseconds in the port transmit queue in front on of this packet (depending on APDU size of node i)           | $\mu s$  |

1181

### 1182 3.3.13 CPF 18 symbols

| Symbol       | Definition                                     | Unit    |
|--------------|------------------------------------------------|---------|
| $l_B$        | Distance along the cable in backward direction | m       |
| $l_C$        | Cable length                                   | m       |
| $l_F$        | Distance along the cable in forward direction  | m       |
| NoDoB        | Number of devices in backward direction        | –       |
| NoDoF        | Number of devices in forward direction         | –       |
| NoS          | Number of switching devices                    | –       |
| $t_{CD}$     | Cable delay                                    | ns/m    |
| $t_{cyc}$    | Cycle time of communication system/relation    | $\mu s$ |
| $t_D$        | Delivery time                                  | $\mu s$ |
| $t_{data}$   | Transmit time of DLPDUs                        | $\mu s$ |
| $t_{pd}$     | Propagation delay                              | $\mu s$ |
| $t_{STsink}$ | Sink stack traversal time                      | $\mu s$ |
| $t_{STsrc}$  | Source stack traversal time                    | $\mu s$ |
| $t_{SW}$     | Delay time of a switch                         | $\mu s$ |

1183 **3.3.14 CPF 20 symbols**

| Symbol      | Description                                                    | Unit    |
|-------------|----------------------------------------------------------------|---------|
| $BW$        | Total bandwidth                                                | %       |
| $BW_{NRTE}$ | Non-RTE bandwidth                                              | %       |
| $BW_{RTE}$  | RTE bandwidth                                                  | %       |
| $CD$        | Cable segment delay                                            | $\mu s$ |
| $CL$        | Cable length                                                   | km      |
| $DL_{CY}$   | Delay of RTE frame on sender node                              | $\mu s$ |
| $DL_{NCY}$  | Delay of Non-RTE frame on sender node                          | $\mu s$ |
| $DL_R$      | Delay of receiver node                                         | $\mu s$ |
| $DL_S$      | Delay of sender node                                           | $\mu s$ |
| $DT$        | Delivery time of RTE                                           | $\mu s$ |
| $F_N$       | The number of frames in the RTE                                | -       |
| $M$         | The number of nodes sending RTE frame                          | -       |
| $MC_{RTE}$  | Common memory capacity                                         | octet   |
| $N$         | The number of nodes between sending and receiving end-stations | -       |
| $PD$        | Cable propagation delay                                        | $\mu s$ |
| $P_{OH}$    | Protocol overhead                                              | $\mu s$ |
| $q$         | The number packets in the port transmit queue                  | $\mu s$ |
| $RD_{HD}$   | Delay of hardware receiving process                            | $\mu s$ |
| $SD_{FM}$   | Delay of sending process by firmware                           | $\mu s$ |
| $SD_{HD}$   | Delay of sending process by hardware                           | $\mu s$ |
| $SD_s$      | Sender stack delay                                             | $\mu s$ |
| $SD_r$      | Receiver stack delay                                           | $\mu s$ |
| $SL$        | Switch latency                                                 | $\mu s$ |
| $SPD$       | Switch processing delay                                        | $\mu s$ |
| $ST_{RTE}$  | Communication cycle time                                       | ms      |
| $T_{CI}$    | Transmit time of control and information communication packet  | $\mu s$ |
| $T_{CN}$    | Transmit time of ring control communication packet             | $\mu s$ |
| $T_{CY}$    | Transmit time of cyclic communication packet                   | $\mu s$ |
| $TR_{RTE}$  | Throughput RTE                                                 | $\mu s$ |
| $T_X$       | Transmit time of target packet                                 | $\mu s$ |
| $T_{X_j}$   | Transmit time of packet j                                      | $\mu s$ |

1184

### 3.3.15 CPF 21 symbols

| Symbol     | Definition                                                                                                                                                                                   | Unit     |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| $BW$       | Total bandwidth in %, and the 100 % is 100 Mbit/s                                                                                                                                            | %        |
| $BW_{nrt}$ | Non-RTE bandwidth                                                                                                                                                                            | %        |
| $BW_{rte}$ | Bandwidth used for the RTE communications                                                                                                                                                    | %        |
| $Cpd_i$    | Signal propagation delay time on the cabling path between end-station #i and #(i+1)                                                                                                          | µs       |
| $Clen_i$   | Cable length of a cable segment #i                                                                                                                                                           | m        |
| $DT$       | Delivery time                                                                                                                                                                                | µs       |
| $DVct$     | Total volume of the cyclic-data sent out by all end-stations                                                                                                                                 | Octets   |
| $NoS$      | Number of switches (including Hub) between sending and receiving end-stations                                                                                                                |          |
| $STTsr_i$  | Sender and Receiver stack traversal time including Phy, MAC, IP, UDP or TCP and FAL processing time of end-station #i                                                                        | µs       |
| $Tct$      | Sum total of the transmission time of all Cyclic-data frames by all end-stations                                                                                                             | µs       |
| $Tctn_i$   | Total number of Cyclic-data frames sent out by end-station #i                                                                                                                                |          |
| $Tcs$      | Sum total of the transmission time up to the permissible count of general Ethernet frame including the general-purpose-server-command transmission                                           |          |
| $Tms$      | Sum total of the transmission time up to the permissible count of message-data frame sporadically requested during one Tttkr time period                                                     | µs       |
| $Tnn$      | is the total number of nodes participating in the logical ring;                                                                                                                              |          |
| $Trmt$     | Refresh-cycle-measurement time which is the elapsed time period from the time after obtaining the token by an end-station until the time the end-station obtains the token once again        | µs       |
| $TRrte$    | Throughput RTE                                                                                                                                                                               | Octets/s |
| $Ttf$      | Packet frame transmission time                                                                                                                                                               | µs       |
| $Tsw_j$    | Sum total of switch (including Hub) latencies on the connection path between end-station #i and #i+1                                                                                         | µs       |
| $Ttk$      | Transmission time of the token frames out of all end-stations including the inter-frame space time for sending out the token frame immediately after sending out the final-cyclic-data frame | µs       |
| $Ttkif_j$  | Inter-frame space time for sending out the token frame immediately after sending out the final-cyclic-data frame by end-station #i                                                           | µs       |
| $Tttkr$    | Target-token-rotation time                                                                                                                                                                   | µs       |

1186

## 3.4 Conventions

### 3.4.1 Conventions common to all layers

#### 3.4.1.1 (Sub)clause selection tables

(Sub)clause selection for all layers is defined in tables, as shown in Table 1 and Table 2. The selected base specifications are indicated just before the selection table(s). Selection is done at the highest (sub)clause level possible to define the profile selection unambiguously.

**Table 1 – Layout of profile (sub)clause selection tables**

| Clause | Header | Presence | Constraints |
|--------|--------|----------|-------------|
|        |        |          |             |

1194

1195

**Table 2 – Contents of (sub)clause selection tables**

| Column      | Text         | Meaning                                                                                              |
|-------------|--------------|------------------------------------------------------------------------------------------------------|
| Clause      | <#>          | (Sub)clause number of the base specifications                                                        |
|             | Next clauses | any following clauses up to the last clause of the base specification                                |
|             | Next Annexes | any following annexes up to the last annex of the base specification                                 |
| Header      | <text>       | (Sub)clause title of the base specifications                                                         |
| Presence    | NO           | This (sub)clause is not included in the profile                                                      |
|             | YES          | This (sub)clause is fully (100 %) included in the profile<br>in this case no further detail is given |
|             | —            | Presence is defined in the following subclauses                                                      |
|             | Partial      | Parts of this (sub)clause are included in the profile                                                |
|             | Optional     | This (sub)clause may be additionally included in the profile                                         |
| Constraints | See <#>      | Constraints/remarks are defined in the given subclause, table or figure of this profile document     |
|             | —            | No constraints other than given in the reference document (sub)clause,<br>or not applicable          |
|             | <text>       | The text defines the constraint directly; for longer text table footnotes or table notes may be used |

1196

1197 If sequences of (sub)clauses do not match the profile, then the numbers are concatenated.

1198 EXAMPLE concatenated subclauses

|           |   |    |   |
|-----------|---|----|---|
| 3.4 – 3.7 | — | NO | — |
|-----------|---|----|---|

1199

### 1200 3.4.1.2 Service selection tables

1201 If the selection of services is defined in a table, the format of Table 3 is used. The table  
1202 identifies the selected services and includes service constraints, as explained in Table 4.

1203

**Table 3 – Layout of service selection tables**

| Service ref. | Service name | Usage | Constraint |
|--------------|--------------|-------|------------|
|              |              |       |            |

1204

1205

**Table 4 – Contents of service selection tables**

| Column       | Text    | Meaning                                                                                              |
|--------------|---------|------------------------------------------------------------------------------------------------------|
| Service ref. | <#>     | (Sub)clause number of the base specifications where the service is defined                           |
|              | —       | Not applicable                                                                                       |
| Service name | <text>  | The name of the service                                                                              |
| Usage        | M       | Mandatory                                                                                            |
|              | O       | Optional                                                                                             |
|              | —       | Service is never used                                                                                |
| Constraints  | See <#> | Constraints/remarks are defined in the given subclause, table or figure of this profile document     |
|              | —       | No constraints other than those given in the reference document (sub)clause, or not applicable       |
|              | <text>  | The text defines the constraint directly; for longer text table footnotes or table notes may be used |

1206

1207 If selection of service parameters is defined in a table the format of Table 5 is used. Each  
 1208 table identifies the selected parameters and includes parameter constraints, as explained in  
 1209 Table 6.

1210

**Table 5 – Layout of parameter selection tables**

| Parameter ref. | Parameter name | Usage | Constraint |
|----------------|----------------|-------|------------|
|                |                |       |            |

1211

1212

**Table 6 – Contents of parameter selection tables**

| Column         | Text    | Meaning                                                                                              |
|----------------|---------|------------------------------------------------------------------------------------------------------|
| Parameter ref. | <#>     | (sub)clause number of the base specifications where the service is defined                           |
|                | —       | Not applicable                                                                                       |
| Parameter name | <text>  | The name of the service parameter                                                                    |
| Usage          | M       | Mandatory                                                                                            |
|                | O       | Optional                                                                                             |
|                | —       | Attribute is never present                                                                           |
| Constraints    | See <#> | Constraints/remarks are defined in the given subclause, table or figure of this profile document     |
|                | —       | No constraints other than those given in the reference document (sub)clause, or not applicable       |
|                | <text>  | The text defines the constraint directly; for longer text table footnotes or table notes may be used |

1213

### 1214 3.4.2 Physical layer

1215 No additional conventions are defined.

### 1216 3.4.3 Data-link layer

#### 1217 3.4.3.1 Service profile conventions

1218 No additional conventions are defined.

### 1219 3.4.3.2 Service and parameter selections

1220 These are described using the common conventions, see 3.4.1.2.

## 1221 3.4.4 Application layer

### 1222 3.4.4.1 Service profile conventions

1223 ASE and class selection is described using (sub)clause selection tables, see 3.4.1.1. If the  
1224 use of selected ASE and classes is further constrained this is specified in the profile (e.g. an  
1225 optional item of the base standard is mandatory in the profile).

1226 If the selection of class attributes is defined in a table the format of Table 7 is used. The table  
1227 identifies the selected class attributes and includes their constraints, as explained in Table 8.

1228 **Table 7 – Layout of class attribute selection tables**

| Attribute | Attribute Name | Usage | Constraint |
|-----------|----------------|-------|------------|
|           |                |       |            |

1230 **Table 8 – Contents of class attribute selection tables**

| Column         | Text    | Meaning                                                                                              |
|----------------|---------|------------------------------------------------------------------------------------------------------|
| Attribute      | <#>     | Attribute number of the base specification class                                                     |
|                | —       | Not applicable                                                                                       |
| Attribute Name | <text>  | The name of the attribute                                                                            |
| Usage          | M       | Mandatory                                                                                            |
|                | O       | Optional                                                                                             |
|                | —       | Attribute is never present                                                                           |
| Constraints    | See <#> | Constraints/remarks are defined in the given subclause, table or figure of this profile document     |
|                | —       | No constraints other than those given in the reference document (sub)clause, or not applicable       |
|                | <text>  | The text defines the constraint directly; for longer text table footnotes or table notes may be used |

### 1232 3.4.4.2 Service and parameter selections

1233 These are described using the common conventions, see 3.4.1.2.

## 1234 4 Conformance to communication profiles

1235 A statement of compliance with an RTE Communication Profile Family (CPF) Profile of this  
1236 part of IEC 61784 shall be stated<sup>2</sup> as either

- 1237 – Compliance to IEC 61784-2:201X CPF n <Type>, or
- 1238 – Compliance to IEC 61784-2 (Ed.4.0) CPF n <Type>

<sup>2</sup> In accordance with ISO/IEC Directives