IEC 61784-2-8

Edition 1.0 2023-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial networks – Profiles – Part 2-8: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 8

Réseaux industriels – Profils – Partie 2-8: Profils de bus de terrain supplémentaires pour les réseaux en temps réel fondés sur l'ISO/IEC/IEEE 8802-3 – CPF 8

IEC 61784-2-8:2023-03(en-fr)

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2023 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, …). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

AVA Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

IEC 61784-2-8

Edition 1.0 2023-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial networks – Profiles – Part 2-8: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 8

Réseaux industriels – Profils – Partie 2-8: Profils de bus de terrain supplémentaires pour les réseaux en temps réel fondés sur l'ISO/IEC/IEEE 8802-3 – CPF 8

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 35.100.20; 35.240.50

ISBN 978-2-8322-6695-3

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

® Registered trademark of the International Electrotechnical Commission
Marque déposée de la Commission Electrotechnique Internationale

Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms, definitions, abbreviated terms, acronyms, and conventions 8
3.1 Terms and definitions 8
3.2 Abbreviated terms and acronyms 8
3.3 Symbols 9
3.4 Conventions 9
4 CPF 8 (CC-Link) – RTE communication profiles 9
4.1 General overview 9
4.2 CP 8/4 9
4.2.1 Physical layer 9
4.2.2 Data link layer 9
4.2.3 Application layer 10
4.2.4 Performance indicator selection 11
4.3 CP 8/5 17
4.3.1 Physical layer 17
4.3.2 Data link layer 17
4.3.3 Application layer 17
4.3.4 Performance indicator selection 19
4.4 CP 8/6 25
4.4.1 Physical layer 25
4.4.2 Data link layer 25
4.4.3 Application layer 26
4.4.4 Performance indicator selection 27
Bibliography 32

Table 1 – CP 8/4: AL service selection 10
Table 2 – CP 8/4: AL protocol selection 11
Table 3 – CP 8/4: PI overview 11
Table 4 – CP 8/4: PI dependency matrix 12
Table 5 – CP 8/4: Consistent set of PIs (real-time only) 16
Table 6 – CP 8/4: Consistent set of PIs (real-time and non-real-time) 17
Table 7 – CP 8/5: AL service selection 18
Table 8 – CP 8/5: AL protocol selection 19
Table 9 – CP 8/5: PI overview 19
Table 10 – CP 8/5: PI dependency matrix 20
Table 11 – CP 8/5: Consistent set of PIs (real-time only) 25
Table 12 – CP 8/5: Consistent set of PIs (real-time and non-real-time) 25
Table 13 – CP 8/6: AL service selection 26
Table 14 – CP 8/6: AL protocol selection 27

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

Table 15 – CP 8/6: Performance indicator overview 28
Table 16 – CP 8/6: Performance indicator dependency matrix 28
Table 17 – CP 8/6: Range of performance indicators 31
Table 18 – CP 8/6: Consistent set of performance indicators 31

Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL NETWORKS – PROFILES –

Part 2-8: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 8

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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 the IEC 61784-1 series and the IEC 61784-2 series.

IEC 61784-2-8 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

This first edition, together with the other parts of the same series, cancels and replaces the fourth edition of IEC 61784-2 published in 2019. This first edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 61784-2:2019:

a) split of the original IEC 61784-2 into several subparts, one subpart for the material of a generic nature, and one subpart for each Communication Profile Family specified in the original document;

b) addition of profile CP 8/6.

The text of this International Standard is based on the following documents:

Draft	Report on voting
65C/1209/FDIS	65C/1237/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC 61784-2 series, published under the general title *Industrial networks – Profiles – Part 2: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

INTRODUCTION

The IEC 61784-2 series provides additional Communication Profiles (CP) to the existing Communication Profile Families (CPF) of the IEC 61784-1 series and additional CPFs with one or more CPs. These profiles meet the industrial automation market objective of identifying Real-Time Ethernet (RTE) communication networks coexisting with ISO/IEC/IEEE 8802-3 – commonly known as Ethernet. These RTE communication networks use provisions of ISO/IEC/IEEE 8802-3 for the lower communication stack layers and additionally provide more predictable and reliable real-time data transfer and means for support of precise synchronization of automation equipment.

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

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

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

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

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

The market is in need of several network solutions, each with different performance characteristics and functional capabilities, matching the diverse application requirements. RTE performance indicators, whose values will be provided with RTE devices based on communication profiles specified in the IEC 61784-2 series, enable the user to match network devices with application-dependent performance requirements of an RTE network.

Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

INDUSTRIAL NETWORKS – PROFILES –

Part 2-8: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 8

1 Scope

This part of IEC 61784-2 defines extensions of Communication Profile Family 8 (CPF 8) for Real-Time Ethernet (RTE). CPF 8 specifies a set of Real-Time Ethernet (RTE) communication profiles (CPs) and related network components based on the IEC 61158 series (Type 23), ISO/IEC/IEEE 8802-3 and other standards.

For each RTE communication profile, this document also specifies the relevant RTE performance indicators and the dependencies between these RTE performance indicators.

NOTE 1 All CPs are based on standards or draft standards or International Standards published by the IEC or on standards or International Standards established by other standards bodies or open standards processes.

NOTE 2 The RTE communication profiles use ISO/IEC/IEEE 8802-3 communication networks and its related network components and in some cases amend those standards to obtain RTE features.

NOTE 3 Some CPs of CPF 8 are specified in IEC 61784-1-8.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

IEC 61158-5-23:2023, *Industrial communication networks – Fieldbus specifications – Part 5-23: Application layer service definition – Type 23 elements*

IEC 61158-6-23:2023, *Industrial communication networks – Fieldbus specifications – Part 6-23: Application layer protocol specification – Type 23 elements*

IEC 61784-2-0:2023, *Industrial networks – Profiles – Part 2-0: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – General concepts and terminology*

IEC 61784-5-8, *Industrial communication networks – Profiles – Part 5-8: Installation of fieldbuses – Installation profiles for CPF 8*

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

Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

IEEE Std 802-2014, *IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture*

IEEE Std 802.1AB-2016, *IEEE Standard for Local and metropolitan area networks – Station and Media Access Control Connectivity Discovery*

IEEE Std 802.1AS-2020, *IEEE Standard for Local and Metropolitan Area Networks – Timing and Synchronization for Time-Sensitive Applications*

IEEE Std 802.1Q-2018, *IEEE Standard for Local and Metropolitan Area Networks – Bridges and Bridged Networks*

IEEE Std 1588-2019, *IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems*

IETF RFC 768, J. Postel, *User Datagram Protocol*, August 1980, available at https://www.rfc-editor.org/info/rfc768 [viewed 2022-02-18]

IETF RFC 791, J. Postel, *Internet Protocol*, September 1981, available at https://www.rfc-editor.org/info/rfc791 [viewed 2022-02-18]

IETF RFC 792, J. Postel, *Internet Control Message Protocol*, September 1981, available at https://www.rfc-editor.org/info/rfc792 [viewed 2022-02-18]

IETF RFC 793, J. Postel, *Transmission Control Protocol*, September 1981, available at https://www.rfc-editor.org/info/rfc793 [viewed 2022-02-18]

3 Terms, definitions, abbreviated terms, acronyms, and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61784-2-0, ISO/IEC/IEEE 8802-3, IEEE Std 802-2014, IEEE Std 802.1AB-2016, IEEE Std 802.1AS-2020 and IEEE Std 802.1Q-2018 apply.

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

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

3.2 Abbreviated terms and acronyms

For the purposes of this document, abbreviated terms and acronyms defined in IEC 61784-2-0 and the following apply.

CP	Communication Profile [according to IEC 61784-1-0]
CPF	Communication Profile Family [according to IEC 61784-1-0]
ICMP	Internet Control Message Protocol (see IETF RFC 792)
IETF	Internet Engineering Task Force
IP	Internet Protocol (see IETF RFC 791)
LLDP	Link Layer Discovery Protocol (see IEEE Std 802.1AB-2016)
n.a.	Not applicable
PI	Performance indicator

Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

RSTP Rapid Spanning Tree Algorithm and Protocol (see IEEE Std 802.1Q-2018)

TCP Transmission Control Protocol (see IETF RFC 793)

UDP User Datagram Protocol (see IETF RFC 768)

3.3 Symbols

For the purposes of this document, symbols defined in IEC 61784-2-0 apply.

3.4 Conventions

For the purposes of this document, the conventions defined in IEC 61784-2-0 apply.

4 CPF 8 (CC-Link) – RTE communication profiles

4.1 General overview

Communication Profile Family 8 defines profiles based on ISO/IEC/IEEE 8802-3, IEC 61158-5-23 and IEC 61158-6-23, which specify the communication system protocols commonly known as CC-Link IE[1].

In this document, the following communication profiles are specified for CPF 8:

– Profile 8/4

  a profile using fiber optic cable in a ring topology or copper cable in linear and star topologies (CC-Link IE Control Network)

– Profile 8/5

  a profile using copper cable in linear and star topologies (CC-Link IE Field Network).

– Profile 8/6

  a profile using fiber optic cable in a ring topology or copper cable in linear and star topologies (CC-Link IE TSN).

4.2 CP 8/4

4.2.1 Physical layer

The physical layer of CP 8/4 is as specified in ISO/IEC/IEEE 8802-3.

The bit rate shall be 1 000 Mbit/s. The full duplex and the auto negotiation function shall not be used.

Recommended connectors, cables and installation guidelines are specified in IEC 61784-5-8.

4.2.2 Data link layer

The data link layer of CP 8/4 is as specified in ISO/IEC/IEEE 8802-3.

---

[1] CC-Link™ and CC-Link IE™ are trade names of Mitsubishi Electric Co. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the trade name holder or any of its products. Compliance with this document does not require use of the trade names CC-Link™ or CC-Link IE™. Use of the trade names CC-Link™ or CC-Link IE™ requires permission of CC-Link Partner Association.

Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

4.2.3 Application layer

4.2.3.1 AL service selection

Application Layer services are defined in IEC 61158-5-23. Table 1 shows the subclauses included in this profile.

Table 1 – CP 8/4: AL service selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	YES	—
3	Terms, definitions, symbols, abbreviated terms and conventions	YES	—
4	Concept	YES	—
5	Data type ASE	YES	—
6	Communication model specification	—	—
6.1	Communication model	YES	—
6.2	ASE	—	—
6.2.1	Overview type C	YES	—
6.2.2	Overview type F	NO	—
6.2.3	Cyclic data ASE type C	YES	—
6.2.4	Cyclic data ASE type F	NO	—
6.2.5	Acyclic data ASE type C	YES	—
6.2.6	Acyclic data ASE type F	NO	—
6.2.7	Management ASE	YES	—
6.2.8	Synchronization ASE	NO	—
6.2.9	Measurement ASE	YES	—
6.3	AR Type C	YES	—
6.4	AR Type F	NO	—

4.2.3.2 AL protocol selection

Application Layer protocols are defined in IEC 61158-6-23. Table 2 shows the subclauses included in this profile.

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

Table 2 – CP 8/4: AL protocol selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	YES	—
3	Terms, definitions, symbols, abbreviated terms and conventions	YES	—
4	FAL syntax description	—	—
4.1	FALPDU type C abstract syntax	YES	—
4.2	FALPDU type F abstract syntax	NO	—
4.3	Data assignmentds for type C	YES	—
4.4	Data assignmentds for type F	NO	—
5	FAL transfer syntax	—	—
5.1	Encoding rules	YES	—
5.2	FALPDU type C elements encoding	YES	—
5.3	FALPDU type F elements encoding	NO	—
6	Structure of the FAL protocol state machine	YES	—
7	FAL service protocol machine (FSPM)	—	—
7.1	Overview	YES	—
7.2	FSPM type C	YES	—
7.3	FSPM type F	NO	—
8	Application relationship protocol machine (ARPM)	—	—
8.1	ARPM type C	YES	—
8.2	ARPM type F	NO	—
9	DLL mapping protocol machine (DMPM)	—	—
9.1	DMPM type C	YES	—
9.2	DMPM type F	NO	—

4.2.4 Performance indicator selection

4.2.4.1 Performance indicator overview

Table 3 provides an overview of the CP 8/4 performance indicators.

Table 3 – CP 8/4: PI overview

Performance indicator	Applicable	Constraints
Delivery time	YES	—
Number of end-stations	YES	—
Basic network topology	YES	—
Number of switches between end-stations	YES	—
Throughput RTE	YES	—
Non-RTE bandwidth	YES	—
Time synchronization accuracy	NO	—
Non-time-based synchronization accuracy	NO	—
Redundancy recovery time	YES	—

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

4.2.4.2 Performance indicator dependencies

Table 4 specifies the dependencies of the performance indicators (row) from the influencing performance indicators (column).

Table 4 – CP 8/4: PI dependency matrix

Dependent PI	Influencing PI							
	Delivery time	Number of end-stations	Basic network topology	Number of switches between end-stations	Throughput RTE	Non-RTE bandwidth	Non-time-based synchronization accuracy	Redundancy recovery time
Delivery time		Yes	No	No	Yes	Yes	No	Yes
Number of end-stations	No		No	No	No	No	No	No
Basic network topology	No	No		No	No	No	No	No
Number of switches between end-stations	No	No	No		No	No	No	No
Throughput RTE	Yes	Yes	No	No		Yes	No	Yes
Non-RTE bandwidth	No	No	No	No	No		No	No
Non-time-based synchronization accuracy	No	No	No	No	No	No		No
Redundancy recovery time	No	No	No	No	No	No	No	

4.2.4.3 Delivery time

4.2.4.3.1 Delivery time calculation

The delivery time between any two end-stations is calculated as the sum of the following:

- *sender delay time* (see 4.2.4.3.2),
- *transmission time* (see 4.2.4.3.3),
- *receiver delay time* (see 4.2.4.3.4).

NOTE Unless otherwise specified, the following units apply: all time units are microseconds, all sizes are octets, and all rates are Mbit/s.

4.2.4.3.2 Sender delay time

4.2.4.3.2.1 Sender delay time calculation

The *sender delay time* is calculated as the sum of the following:

- *send buffer transfer time* (see 4.2.4.3.2.2),
- *frame transmission time* (see 4.2.4.3.2.3),
- *transmission delay time* (see 4.2.4.3.2.4).

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

4.2.4.3.2.2 Send buffer transfer time

The *send buffer transfer time* is calculated as the product of the following:

- *cyclic data transfer size*,
- *send buffer transfer time* (µs/octet).

The *send buffer transfer time* is specified by the manufacturer. A typical value is 0,01 µs/octet.

4.2.4.3.2.3 Frame transmission time

The *frame transmission time* is calculated as the sum of the following:

- *cyclic data transfer time*,
- *cyclic data header transfer time*,
- *frame gap time*,
- *preamble time*.

The *cyclic data transfer time* is calculated as shown in Formula (1):

$$\textit{cyclic data transfer time} = \textit{cyclic data transfer size} \times 8 / \textit{transmission rate} \quad (1)$$

The *transmission rate* is specified by the manufacturer. A typical value is 1 000 Mbit/s.

The *cyclic data header transfer time* is calculated as shown in Formula (2):

$$\textit{cyclic data header transfer time} = 44 \times \textit{number of cyclic data frames} \times 8 / \textit{transmission rate} \quad (2)$$

The *number of cyclic data frames* is calculated as shown in Formula (3):

$$\textit{number of cyclic data frames} = 1 + (\textit{cyclic data transfer size} / (1\,518 - 44)) \quad (3)$$

NOTE In Formula (3) the calculated value is truncated to yield an integer result.

The *frame gap time* is calculated as shown in Formula (4):

$$\textit{frame gap time} = 12 \times (\textit{number of cyclic data frames} - 1) \times 8 / \textit{transmission rate} \quad (4)$$

The *preamble time* is calculated as shown in Formula (5):

$$\textit{preamble time} = 8 \times (\textit{number of cyclic data frames} - 1) \times 8 / \textit{transmission rate} \quad (5)$$

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

4.2.4.3.2.4 Transmission delay time

The *transmission delay time* is specified by the manufacturer. A typical value is 0,35 µs.

4.2.4.3.3 Transmission time

4.2.4.3.3.1 Transmission time calculation

The *transmission time* is calculated as the sum of the following:

- *repeaters delay time* (see 4.2.4.3.3.2),
- *transmission channel delay time* (see 4.2.4.3.3.3).

4.2.4.3.3.2 Repeaters delay time

The *repeater delay time* is calculated as shown in Formula (6):

$$\textit{repeater delay time} = \textit{repeater delay time} \times (\textit{number of stations} - 2) \quad (6)$$

The *repeater delay time* is specified by the manufacturer. A typical value is 0,7 µs.

4.2.4.3.3.3 Transmission channel delay time

The *transmission channel delay time* is calculated as shown in Formula (7):

$$\textit{transmission channel delay time} = \textit{transmission channel length (Km)} / 210\,000\ \textit{(Km/s)} \quad (7)$$

4.2.4.3.4 Receiver delay time

4.2.4.3.4.1 Receiver delay time calculation

The *receiver delay time* is calculated as shown in Formula (8):

$$\textit{receiver delay time} = \textit{receive delay time} + \textit{receive buffer transfer time} \quad (8)$$

See 4.2.4.3.4.2 for receive delay time and 4.2.4.3.4.3 for receive buffer transfer time.

4.2.4.3.4.2 Receive delay time

The *receive delay time* is specified by the manufacturer. A typical value is 0,35 µs.

4.2.4.3.4.3 Receive buffer transfer time

The *receive buffer transfer time* is calculated as shown in Formula (9):

$$\textit{receive buffer transfer time} = \textit{cyclic data transfer size} \times \textit{receive buffer transfer time (µs/octet)} \quad (9)$$

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

The *receive buffer transfer time* is specified by the manufacturer. A typical value is 0,01 µs/octet.

4.2.4.4 Number of end-stations

The maximum number of end-stations is 256. This value is not influenced by any other PI.

4.2.4.5 Basic network topology

The basic network topology, a ring, is fixed.

4.2.4.6 Number of switches between end-stations

No switches are used.

4.2.4.7 Throughput RTE

The *Throughput RTE* is calculated as shown in Formula (10):

$$\textit{throughput RTE} = \textit{cyclic data transfer size} \times 8 / \textit{token circulation time} \tag{10}$$

The *token circulation time* is calculated as shown in Formula (11):

$$\textit{token circulation time} = (\textit{sender delay time} + \textit{transmission channel delay time} + \textit{receiver delay time} + \textit{token frame time}) \times \textit{number of stations} \tag{11}$$

The *token frame time* is calculated as shown in Formula (12):

$$\textit{token frame time} = 64 \times 8 / \textit{transmission rate} \tag{12}$$

4.2.4.8 Non-RTE bandwidth

The *non-RTE bandwidth* is influenced by the *throughput RTE*. The relationship shown in Formula (13) expressed as a ratio of two rates (all terms are Mbit/s), describes this dependency:

$$\textit{non-RTE bandwidth} < (\textit{transmission rate} - \textit{throughput RTE} - \textit{protocol overhead}) / \textit{transmission rate} \tag{13}$$

The *protocol overhead* is calculated as the sum of the following:

- *cyclic data overhead*,
- *acyclic data overhead*.

Documents
Document Sharing Hub

Full document details: IEC 61784-2-8-2023

The *cyclic data overhead* is calculated as shown in Formula (14):

$$\textit{cyclic data overhead} = (44 \times 8 / \textit{token circulation time}) \times \textit{number of cyclic data frames} \quad (14)$$

The *acyclic data overhead* is calculated as shown in Formula (15):

$$\textit{acyclic data overhead} = (44 \times 8 / \textit{token circulation time}) \times \textit{number of acyclic data frames} \quad (15)$$

The *number of acyclic data frames* is calculated as in Formula (16):

$$\textit{number of acyclic data frames} = 1 + (\textit{acyclic data transfer size} / (1\ 518 - 48)) \quad (16)$$

NOTE The value of number of acyclic data frames calculated with Formula (16) is truncated to yield an integer result.

4.2.4.9 Time synchronization accuracy

Void.

4.2.4.10 Non-time-based synchronization accuracy

Void.

4.2.4.11 Redundancy recovery time

The *redundancy recovery time* is not dependent on any other PI. The *redundancy recovery time* influences delivery time and throughput RTE. The influence on *delivery time* is not parametric because the transmission protocol does not include the retransmission procedure; however, a redundancy recovery event has a direct correlation on *throughput RTE* as influenced by the change in transmission pass.

4.2.4.12 Consistent set of performance indicators for large automation systems

Table 5 gives an outline of a consistent set of performance indicators for a large automation system.

Table 5 – CP 8/4: Consistent set of PIs (real-time only)

Performance indicator	Value	Constraints
Delivery time	200 µs	No failure
Number of end-stations	120	Ring topology
Number of switches between end-stations	n.a.	—
Throughput RTE	50 Moctets/s	—
Non-RTE bandwidth	0	In this scenario, non-RTE traffic is not configured although possible.
Redundancy recovery time	< 100 ms	—

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

Table 6 gives an outline of a consistent set of performance indicators for a large automation system. The slot for no-real-time data is 240 000 octets per cycle time.

Table 6 – CP 8/4: Consistent set of PIs (real-time and non-real-time)

Performance indicator	Value	Constraints
Delivery time	217 µs	No failure
Number of end-stations	120	Ring topology
Number of switches between end-stations	n.a.	—
Throughput RTE	35 Moctets/s	—
Non-RTE bandwidth	48,4 %	In this scenario, the slot for no-real-time data is 240 000 octets per cycle time.
Redundancy recovery time	< 100 ms	—

4.3 CP 8/5

4.3.1 Physical layer

The physical layer of CP 8/5 is as specified in ISO/IEC/IEEE 8802-3.

4.3.2 Data link layer

The data link layer of CP 8/5 is as specified in ISO/IEC/IEEE 8802-3.

4.3.3 Application layer

4.3.3.1 AL service selection

Application Layer services are defined in IEC 61158-5-23. Table 7 shows the subclauses included in this profile.

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

Table 7 – CP 8/5: AL service selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	YES	—
3	Terms, definitions, symbols, abbreviated terms and conventions	YES	—
4	Concept	YES	—
5	Data type ASE	YES	—
6	Communication model specification	—	—
6.1	Communication model	YES	—
6.2	ASE	—	—
6.2.1	Overview type C	NO	—
6.2.2	Overview type F	YES	—
6.2.3	Cyclic data ASE type C	NO	—
6.2.4	Cyclic data ASE type F	YES	—
6.2.5	Acyclic data ASE type C	NO	—
6.2.6	Acyclic data ASE type F	YES	—
6.2.7	Management ASE	YES	—
6.2.8	Synchronization ASE	YES	—
6.2.9	Measurement ASE	YES	—
6.3	AR Type C	NO	—
6.4	AR Type F	YES	—

4.3.3.2 AL protocol selection

Application Layer protocols are defined in IEC 61158-6-23. Table 8 shows the subclauses included in this profile.

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023

Table 8 – CP 8/5: AL protocol selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	YES	—
3	Terms, definitions, symbols, abbreviated terms and conventions	YES	—
4	FAL syntax description	—	—
4.1	FALPDU type C abstract syntax	NO	—
4.2	FALPDU type F abstract syntax	YES	—
4.3	Data assignmentds for type C	NO	—
4.4	Data assignmentds for type F	YES	—
5	FAL transfer syntax	—	—
5.1	Encoding rules	YES	—
5.2	FALPDU type C elements encoding	NO	—
5.3	FALPDU type F elements encoding	YES	—
6	Structure of the FAL protocol state machine	YES	—
7	FAL service protocol machine (FSPM)	—	—
7.1	Overview	YES	—
7.2	FSPM type C	NO	—
7.3	FSPM type F	YES	—
8	Application relationship protocol machine (ARPM)	—	—
8.1	ARPM type C	NO	—
8.2	ARPM type F	YES	—
9	DLL mapping protocol machine (DMPM)	—	—
9.1	DMPM type C	NO	—
9.2	DMPM type F	YES	—

4.3.4 Performance indicator selection

4.3.4.1 Performance indicator overview

Table 9 provides an overview of the CP 8/5 performance indicators.

Table 9 – CP 8/5: PI overview

Performance indicator	Applicable	Constraints
Delivery time	YES	—
Number of end-stations	YES	—
Basic network topology	YES	—
Number of switches between end-stations	YES	—
Throughput RTE	YES	—
Non-RTE bandwidth	YES	—
Time synchronization accuracy	NO	—
Non-time-based synchronization accuracy	YES	—
Redundancy recovery time	YES	—

Documents
Document Sharing Hub
Full document details: IEC 61784-2-8-2023