IEC 61784-2-17

Edition 1.0 2023-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Industrial networks – Profiles –
Part 2-17: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 17

Réseaux industriels – Profils –
Partie 2-17: Profils de bus de terrain supplémentaires pour les réseaux en temps réel fondés sur l'ISO/IEC/IEEE 8802-3 – CPF 17

IEC 61784-2-17:2023-05(en-fr)

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

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

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

IEC 61784-2-17 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

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.

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- withdrawn,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.

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.

INDUSTRIAL NETWORKS – PROFILES –

Part 2-17: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – CPF 17

1 Scope

This part of IEC 61784-2 defines Communication Profile Family 17 (CPF 17). CPF 17 specifies a Real-Time Ethernet (RTE) communication profile (CP) and related network components based on the IEC 61158 series (Type 21), 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 profile uses ISO/IEC/IEEE 8802-3 communication networks and its related network components and in some cases amend those standards to obtain RTE features.

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 61158-3-21:2019, *Industrial communication networks – Fieldbus specifications – Part 3-21: Data-link layer service definition – Type 21 elements*

IEC 61158-4-21:2023, *Industrial communication networks – Fieldbus specifications – Part 4-21: Data-link layer protocol specification – Type 21 elements*

IEC 61158-5-21:2019, *Industrial communication networks – Fieldbus specifications – Part 5-21: Application layer service definition – Type 21 elements*

IEC 61158-6-21:2019, *Industrial communication networks – Fieldbus specifications – Part 6-21: Application layer protocol specification – Type 21 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*

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

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*

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
Phy	PHY Physical layer entity sublayer (see ISO/IEC/IEEE 8802-3)
PI	Performance indicator
pps	Packets per second
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 and Table 1 apply.

NOTE Definitions of symbols in this Subclause 3.3 do not use the italic font, as they are already identified as symbols.

Table 1 – CPF 17 symbols

Symbol	Definition	Unit
APDUsize	Size of the application protocol data unit in octets	octets
BW_{NRTE}	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_{E/S_MAX}	Maximum number of frames allowed to be sent per second for one end station	pps
$NF_{RTE/S}$	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	µs
$T_{CPD/M}$	Cable propagation delay in nanoseconds per meter (depending on the characteristics of the selected cable)	ns/m
T_{DELAY}	Delivery time in microseconds	µs
T_{DELAY_MAX}	Maximum delivery time in microseconds	µs
T_{DELAY_MIN}	Minimum delivery time in microseconds	µs
Throughput_RTE	Throughput RTE	octets/s
$Throughput\_RTE_{MAX}$	Maximum throughput RTE	octets/s
T_{NLD}	Node latency delay time in microseconds	µs
T_{NLD_i}	Node latency delay time of node i in microseconds	µs
T_{NPD}	Node propagation delay time in microseconds	µs
T_{NPD_i}	Node propagation delay time of node i in microseconds	µs
T_{PKT}	Packet transmit time in microseconds	µs
T_{PKT_i}	Packet transmit time of node i in microseconds	µs
T_{RCV}	Receiver stack traversal time including Phy and MAC in microseconds	µs
T_{SND}	Sender stack traversal time including Phy and MAC in microseconds	µs
$T_{TX\_PKT\_ij}$	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)	µs
$T_{TX\_PKT\_j}$	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)	µs

3.4 Conventions

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

4 CPF 17 (RAPIEnet) – RTE communication profiles

4.1 General overview

Communication Profile Family 17 (CPF 17) defines one communication profile based on the IEC 61158 series protocol Type 21. This profile corresponds to the communication system commonly known as RAPIEnet.

- Profile 17/1 (RAPIEnet)

  This profile is based on ISO/IEC/IEEE 8802-3 (Ethernet) MAC and physical layers and selections of AL, and DLL services and protocol definitions from the IEC 61158 series Type 21.

Table 2 shows the overview of RAPIEnet profile set.

Table 2 – CPF 17: Overview of profile sets

Layer	Profile 17/1
Application	IEC 61158-5-21, IEC 61158-6-21
Data-link	IEC 61158-3-21, IEC 61158-4-21
Physical	ISO/IEC/IEEE 8802-3

4.2 CP 17/1

4.2.1 Physical layer

The physical layer shall be according to ISO/IEC/IEEE 8802-3.

The data rate shall be at least 100 Mbit/s and full-duplex mode shall be used at least for one port.

The auto negotiation and crossover function (see ISO/IEC/IEEE 8802-3) shall be used.

4.2.2 Datalink layer

4.2.2.1 DLL services selection

Table 3 specifies the DLL service selection within IEC 61158-3-21.

Table 3 – CP 17/1: DLL service selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	YES	—
3	Terms, definitions, symbols, abbreviations and conventions	Partial	If applicable
4	Data-link layer services and concepts	YES	—
5	Data-link management services	YES	—
6	MAC control service	YES	—
7	Ph-control service	YES	—

4.2.2.2 DLL protocol selection

Table 4 specifies the DLL protocol selection within IEC 61158-4-21.

Table 4 – CP 17/1: DLL protocol selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	YES	—
3	Terms, definitions, symbols and abbreviations	Partial	If applicable
4	Overview of the data-link protocol	YES	—
5	General structure and encoding	YES	—
6	DLPDU structure and procedure	YES	—
7	DLE elements of procedure	YES	—
8	Constants and error codes	YES	—

4.2.3 Application layer

4.2.3.1 AL service selection

Table 5 specifies the AL service selection within IEC 61158-5-21.

Table 5 – CP 17/1: AL service selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	YES	—
3	Terms, definitions, symbols, abbreviations, and conventions	Partial	If applicable
4	Concepts	YES	—
5	Data type ASE	YES	—
6	Communication model specification	YES	—

4.2.3.2 AL protocol selection

Table 6 specifies the AL protocol selection within IEC 61158-6-21.

Table 6 – CP 17/1: AL protocol selection

Clause	Header	Presence	Constraints
1	Scope	YES	—
2	Normative references	YES	—
3	Terms, definitions, symbols, abbreviations, and conventions	Partial	If applicable
4	FAL syntax description	YES	—
5	Transfer Syntax	YES	—
6	FAL protocol state machines	YES	—
7	AP context state machine	YES	—
8	FAL service protocol machine	YES	—
9	AR protocol machine	YES	—
10	DLL mapping protocol machine	YES	—