IEC 61784-2-0

Edition 1.0 2023-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Réseaux industriels – Profils – Partie 2-0: Profils de bus de terrain supplémentaires pour les réseaux en temps réel fondés sur l'ISO/IEC/IEEE 8802-3 – Concepts généraux et terminologie

IEC 61784-2-0:2023-03(en-fr)

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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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INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL NETWORKS – PROFILES –

Part 2-0: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – General concepts and terminology

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

IEC 61784-2-0 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.

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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,
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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.

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INDUSTRIAL NETWORKS – PROFILES –

Part 2-0: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3 – General concepts and terminology

1 Scope

The IEC 61784-2 series defines additional Communication Profiles (CPs) for the existing Communication Profile Families (CPFs) of the IEC 61784-1 series and additional CPFs with one or more CPs. These additional CPs are based on the IEC 61158 series, the IEC 61784-1 series, and use provisions from ISO/IEC/IEEE 8802-3 (commonly known as Ethernet) for the lower communication stack layers. These Real-Time Ethernet (RTE) communication profiles provide Real-Time Ethernet communication solutions able to coexist with ISO/IEC/IEEE 8802-3 based applications.

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 or IEC 61588 and in some cases amend those standards to obtain RTE features.

This part of IEC 61784-2 defines:

- a common terminology for all CPFs in the IEC 61784-2 series (see 3.1 to 3.3);
- conventions to be used in the specification of the RTE communication profiles (see 3.4);
- how conformance of a device to a CPF or a CP should be stated (see Clause 4).

This document also specifies:

- basic principles of performance indicators expressing RTE performance of a CP (see 5.1);
- how an application-dependent class could be used to find out a suitable CP to meet application requirements (see 5.2);
- characteristics of RTE performance indicators (see 5.3);
- the methodology of a conformance test for an RTE end device for one or more CPs (see Clause 6).

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 61784-1 (all parts), *Industrial networks – Profiles – Part 1: Fieldbus profiles*

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IEC 61784-2 (all parts), *Industrial networks – Profiles – Part 2: Additional real-time fieldbus profiles based on ISO/IEC/IEEE 8802-3*

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*

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 ISO/IEC/IEEE 8802-3, IEEE Std 802-2014, IEEE Std 802.1AB-2016, IEEE Std 802.1AS-2020, IEEE Std 802.1Q-2018, and the following, 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

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

[SOURCE: IEC 61918:2018, 3.1.3, modified – The note to entry has been deleted]

3.1.2
cyclic
repetitive in a regular manner

3.1.3
end-station
system attached to a network that is an initial source or a final destination of MAC frames transmitted across that network

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

3.1.4
field area
place in a manufacturing or process site where field devices are located

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3.1.5
frame
unit of data transmission on an ISO/IEC/IEEE 8802-3 MAC (Media Access Control) that conveys a protocol data unit (PDU) between MAC service users

[SOURCE: IEEE Std 802.1Q-2018 – modified in accordance with IEC formatting and references]

3.1.6
jitter
temporal change in clock signal or temporal change in otherwise regular event

3.1.7
linear topology
topology where the nodes are connected in series, with two nodes connected to only one other node and all others each connected to two other nodes (that is, connected in the shape of a line)

[SOURCE: IEC 61918:2018, 3.1.51, modified − The note to entry has been deleted]

3.1.8
link
transmission path between two adjacent nodes

[SOURCE: ISO/IEC 11801-1:2017, 3.1.59, modified – "cabling system interfaces, including the connections at each end" has been replaced by "nodes"]

3.1.9
message
ordered series of octets intended to convey information

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

[SOURCE: IEC 61158-1, 3.1.4, modified – The note to entry has been added]

3.1.10
node
network entity connected to one or more links

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

3.1.11
packet
logical grouping of information used to describe a unit of data at any layer to convey the upper layer user data to its peer layer

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

3.1.12
real-time
ability of a system to provide a required result in a bounded time

3.1.13
real-time communication
transfer of data in real time

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3.1.14
Real-Time Ethernet
RTE
ISO/IEC/IEEE 8802-3 based network that includes real-time communication

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

Note 2 to entry: This definition is dedicated but not limited to ISO/IEC/IEEE 8802-3. It could be applicable to other IEEE Std 802 specifications, for example IEEE Std 802.11-2020.

3.1.15
ring
active network where each node is connected in series to two other nodes

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

[SOURCE: IEC 61918:2018, 3.1.71, modified – The note to entry has been added]

3.1.16
RTE end device
device with at least one RTE end-station

3.1.17
RTE end-station
end-station with RTE capability

3.1.18
schedule
temporal arrangement of a number of related operations

3.1.19
star
network of three or more devices where all devices are connected to a central point

[SOURCE: IEC 61918:2018, 3.1.77, modified – "(which may be active or passive)" has been suppressed]

3.1.20
switch
MAC bridge as defined in IEEE Std 802.1Q-2018

3.2 Abbreviated terms and acronyms

AL	Application Layer
APDU	Application Protocol Data Unit
AR	Application Relationship
ARP	Address Resolution Protocol
ASE	Application Service Element
CP	Communication Profile [according to IEC 61784-1-0]
CPF	Communication Profile Family [according to IEC 61784-1-0]
DL	Data-Link layer (as a prefix)
DLL	DL-Layer
DUT	Device under test
IANA	Internet Assigned Numbers Authority
ICMP	Internet Control Message Protocol (see IETF RFC 792)

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ID	Identifier
IETF	Internet Engineering Task Force
IO	Input Output
IP	Internet Protocol (see IETF RFC 791)
LAN	Local Area Network
LLC	Logical Link Control
LLDP	Link Layer Discovery Protocol (see IEEE Std 802.1AB-2016)
MAC	Media Access Control (see ISO/IEC/IEEE 8802-3)
Mbit/s	Million bits per second
Moctets/s	Million octets per second
MIB	Management Information base
ms	milliseconds
n.a.	Not applicable
NoS	Number of Switches
NRT	Non-real-time
PDU	Protocol Data Unit
PI	Performance indicator
ns	nanoseconds
PDU	Protocol Data Unit
PhL	Physical Layer
Phy	PHY Physical layer entity sublayer (see ISO/IEC/IEEE 8802-3)
PI	Performance indicator
PTP	Precision Time Protocol (see IEC 61588)
RSTP	Rapid Spanning Tree Algorithm and Protocol (see IEEE Std 802.1Q-2018)
RT	Real-time
RTE	Real-time Ethernet
SNMP	Simple Network Management Protocol (see IETF RFC 1157)
TCP	Transmission Control Protocol (see IETF RFC 793)
UDP	User Datagram Protocol (see IETF RFC 768)
VLAN	Virtual LAN

3.3 Common symbols

No common symbols defined.

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.

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

Clause	Header	Presence	Constraints

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 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, or not applicable
	<text>	The text defines the constraint directly; for longer text table footnotes or table notes may be used

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

EXAMPLE concatenated subclauses

3.4 – 3.7	—	NO	—

3.4.1.2 Service selection tables

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

Table 3 – Layout of service selection tables

Service ref.	Service name	Usage	Constraint

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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

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

Table 5 – Layout of parameter selection tables

Parameter ref.	Parameter name	Usage	Constraint

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

3.4.2 Physical layer

No additional conventions are defined.

3.4.3 Data-link layer

3.4.3.1 Service profile conventions

No additional conventions are defined.

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