INTERNATIONAL STANDARD

ISO/IEC/IEEE 8802-1CM

First edition
2019-07

AMENDMENT 1
2021-10

Telecommunications and information exchange between information technology systems — Requirements for local and metropolitan area networks —

Part 1CM: Time-sensitive networking for fronthaul

AMENDMENT 1: Enhancements to fronthaul profiles to support new fronthaul interface, synchronization, and syntonization standards

Télécommunications et échange entre systèmes informatiques — Exigences pour les réseaux locaux et métropolitains —

Partie 1CM: Réseaux à temps critique pour fronthaul

AMENDEMENT 1: Perfectionnement des profils fronthaul pour la prise en charge de la nouvelle interface fronthaul, normes de synchronisation et de recherche

Reference number
ISO/IEC/IEEE 8802-1CM:2019/Amd.1:2021(E)

© IEEE 2020



COPYRIGHT PROTECTED DOCUMENT

© IEEE 2020

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from IEEE at the address below.

Institute of Electrical and Electronics Engineers, Inc
3 Park Avenue, New York
NY 10016-5997, USA

Email: stds.ipr@ieee.org
Website: www.ieee.org

Published in Switzerland

© IEEE 2020 – All rights reserved

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO/IEC documents should be noted (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. The IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. While the IEEE administers the process and establishes rules to promote fairness in the consensus development process, the IEEE does not independently evaluate, test, or verify the accuracy of any of the information contained in its standards.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

ISO/IEC/IEEE 8802-1CM:2019/Amd 1 was prepared by the LAN/MAN of the IEEE Computer Society (as IEEE Std 802.1CMde-2020) and drafted in accordance with its editorial rules. It was adopted, under the "fast-track procedure" defined in the Partner Standards Development Organization cooperation agreement between ISO and IEEE, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

A list of all parts in the ISO/IEC/IEEE 8802 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Copyright © 2020 IEEE. All rights reserved.

IEEE Std 802.1CMde™-2020
(Amendment to IEEE Std 802.1CM™-2018)

IEEE Standard for
Local and metropolitan area networks—

Time-Sensitive Networking for Fronthaul

Amendment 1: Enhancements to Fronthaul Profiles to Support New Fronthaul Interface, Synchronization, and Syntonization Standards

Developed by the

LAN/MAN Standards Committee
of the
IEEE Computer Society

Approved 4 June 2020

IEEE SA Standards Board

Abstract: Enhancements to fronthaul profiles are defined in this amendment to IEEE Std 802.1CM™-2018 in order to address new developments in fronthaul interface standards and in related synchronization and syntonization standards.

Keywords: amendment, bridged network, CPRI, eCPRI, F1, fronthaul, IEEE 802®, IEEE 802.1™, IEEE 802.1CM™, IEEE 802.1CMde™, synchronization, time-sensitive networking, TSN, Virtual Local Area Network, VLAN, VLAN Bridge

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

Copyright © 2020 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 16 October 2020. Printed in the United States of America.

IEEE and IEEE 802 are registered trademarks in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-1-5044-6814-5 STD24245
Print: ISBN 978-1-5044-6815-2 STDPD24245

IEEE prohibits discrimination, harassment and bullying.

For more information, visit https://www.ieee.org/about/corporate/governance/p9-26.html.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE Standards documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page (https://standards.ieee.org/ipr/disclaimers.html), appear in all standards and may be found under the heading "Important Notices and Disclaimers Concerning IEEE Standards Documents."

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE SA) Standards Board. IEEE develops its standards through an accredited consensus development process, which brings together volunteers representing varied viewpoints and interests to achieve the final product. IEEE Standards are documents developed by volunteers with scientific, academic, and industry-based expertise in technical working groups. Volunteers are not necessarily members of IEEE or IEEE SA, and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE does not warrant or represent the accuracy or completeness of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to results and workmanlike effort. In addition, IEEE does not warrant or represent that the use of the material contained in its standards is free from patent infringement. IEEE Standards documents are supplied "AS IS" and "WITH ALL FAULTS."

Use of an IEEE standard is wholly voluntary. The existence of an IEEE Standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity, nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: THE NEED TO PROCURE SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE is the approved IEEE standard.

Copyright © 2020 IEEE. All rights reserved.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, nor be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that the presenter's views should be considered the personal views of that individual rather than the formal position of IEEE, IEEE SA, the Standards Committee, or the Working Group.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE or IEEE SA. However, **IEEE does not provide interpretations, consulting information, or advice pertaining to IEEE Standards documents**.

Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its Societies and Standards Coordinating Committees are not able to provide an instant response to comments, or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in evaluating comments or in revisions to an IEEE standard is welcome to join the relevant IEEE working group. You can indicate interest in a working group using the Interests tab in the Manage Profile & Interests area of the IEEE SA myProject system. An IEEE Account is needed to access the application.

Comments on standards should be submitted using the Contact Us form.

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not constitute compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Data privacy

Users of IEEE Standards documents should evaluate the standards for considerations of data privacy and data ownership in the context of assessing and using the standards in compliance with applicable laws and regulations.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under US and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

Photocopies

Subject to payment of the appropriate licensing fees, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400; https://www.copyright.com/. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Copyright © 2020 IEEE. All rights reserved.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every 10 years. When a document is more than 10 years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit IEEE Xplore or contact IEEE. For more information about the IEEE SA or IEEE's standards development process, visit the IEEE SA Website.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE SA Website. Search for standard number and year of approval to access the web page of the published standard. Errata links are located under the Additional Resources Details section. Errata are also available in IEEE Xplore. Users are encouraged to periodically check for errata.

Patents

IEEE Standards are developed in compliance with the IEEE SA Patent Policy.

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE SA Website at https://standards.ieee.org/about/sasb/patcom/patents.html. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

IMPORTANT NOTICE

IEEE Standards do not guarantee or ensure safety, security, health, or environmental protection, or ensure against interference with or from other devices or networks. IEEE Standards development activities consider research and information presented to the standards development group in developing any safety recommendations. Other information about safety practices, changes in technology or technology implementation, or impact by peripheral systems also may be pertinent to safety considerations during implementation of the standard. Implementers and users of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

Copyright © 2020 IEEE. All rights reserved.

Participants

At the time this amendment was submitted to the IEEE SA Standards Board for approval, the IEEE 802.1 Working Group had the following membership:

Glenn Parsons, *Chair*
John Messenger, *Vice Chair*
János Farkas, *Chair, Time-Sensitive Networking Task Group*
Craig Gunther, *Vice Chair, Time-Sensitive Networking Task Group*

Astrit Ademaj
Ralf Assmann
Jens Bierschenk
Christian Boiger
Paul Bottorff
Feng Chen
Weiying Cheng
Paul Congdon
Rodney Cummings
Josef Dorr
Hesham Elbakoury
Thomas Enzinger
Donald Fedyk
Norman Finn
Geoffrey Garner
Marina Gutierrez
Stephen Haddock
Mark Hantel
Marc Holness
Satoko Itaya
Yoshihiro Ito
Michael Karl
Stephan Kehrer
Randy Kelsey
Hajime Koto
James Lawlis
Christophe Mangin
Scott Mansfield
Kenichi Maruhashi
Larry McMillan
Tero Mustala
Roy Myers
Tomoki Ohsawa
Hiroshi Ohue
Donald Pannell
Michael Potts
Wei Qiu
Karen Randall
Maximilian Riegel
Jessy Rouyer
Atsushi Sato
Frank Schewe
Michael Seaman
Maik Seewald
Johannes Specht
Marius Stanica
Guenter Steindl
Xinyuan Wang
Tongtong Wang
Hao Wang
Karl Weber
Brian Weis
Ludwig Winkel
Jordon Woods
Takahiro Yamaura
Nader Zein
Helge Zinner
Harald Zweck

Copyright © 2020 IEEE. All rights reserved.

The following members of the individual balloting committee voted on this amendment. Balloters may have voted for approval, disapproval, or abstention.

Thomas Alexander
Carol Ansley
Butch Anton
Greg Armstrong
Christian Boiger
Vern Brethour
Matthew Brown
Demetrio Bucaneg
William Byrd
Paul Cardinal
Juan Carreon
Pin Chang
Charles Cook
Marc Emmelmann
János Farkas
Avraham Freedman
Geoffrey Garner
Joel Goergen
Randall Groves
Craig Gunther
Stephen Haddock
Marco Hernandez
Werner Hoelzl
Oliver Holland
Woojung Huh
Atsushi Ito
Raj Jain
SangKwon Jeong
Lokesh Kabra
Srinivas Kandala
Randy Kelsey
Stuart Kerry
Evgeny Khorov
Yongbum Kim
Hyeong Ho Lee
Kang Lee
Jennifer Lemon
Joseph Levy
Arthur Marris
Jeffery Masters
Michael Maytum
Richard Mellitz
Nick S. A. Nikjoo
Satoshi Obara
Glenn Parsons
Bansi Patel
Arumugam Paventhan
David Piehler
Walter Pienciak
Clinton Powell
R. K. Rannow
Alon Regev
Maximilian Riegel
Robert Robinson
Silvana Rodrigues
Benjamin Rolfe
Jessy Rouyer
Frank Schewe
Veselin Skendzic
Thomas Starai
Walter Struppler
Bo Sun
Karim Traore
Richard Tse
Mark-Rene Uchida
Dmitri Varsanofiev
John Vergis
George Vlantis
Lisa Ward
Karl Weber
Stuart Whitehead
Scott Willy
Andreas Wolf
Chi Xu
Yu Yuan
Oren Yuen
Nader Zein

When the IEEE SA Standards Board approved this amendment on 4 June 2020, it had the following membership:

Gary Hoffman, *Chair*
Jon Walter Rosdahl, *Vice Chair*
John D. Kulick, *Past Chair*
Konstantinos Karachalios, *Secretary*

Ted Burse
Doug Edwards
J. Travis Griffith
Grace Gu
Guido R. Hiertz
Joseph L. Koepfinger*
David J. Law
Howard Li
Dong Liu
Kevin Lu
Paul Nikolich
Damir Novosel
Dorothy Stanley
Mehmet Ulema
Lei Wang
Sha Wei
Philip B. Winston
Daidi Zhong
Jingyi Zhou

*Member Emeritus

Copyright © 2020 IEEE. All rights reserved.

Introduction

This introduction is not part of IEEE Std 802.1CMde-2020, IEEE Standard for local and metropolitan area networks—Time-Sensitive Networking for Fronthaul—Amendment 1: Enhancements to Fronthaul Profiles to Support New Fronthaul Interface, Synchronization, and Syntonization Standards.

This amendment to IEEE Std 802.1CM-2018 defines enhancements to fronthaul profiles in order to address new developments in fronthaul interface standards and in related synchronization and syntonization standards.

The standard contains state-of-the-art material. The area covered by this standard is undergoing evolution. Revisions are anticipated within the next few years to clarify existing material, to correct possible errors, and to incorporate new related material. Information on the current revision state of this and other IEEE 802® standards may be obtained from

Secretary, IEEE SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854 USA.

Acknowledgments

Permissions have been granted as follows:

Figure 11.1.1-1 of 3GPP™ TR 38.801 reprinted as Figure C-1 in this document with permission from 3GPP © 2017. 3GPP™ technical specifications (TSs) and technical reports (TRs) are the property of ARIB, ATIS, CCSA, ETSI, TSDSI, TTA and TTC who jointly own the copyright in them. They are subject to further modifications and are therefore provided to you “as is” for information purposes only. Further use is strictly prohibited.

Copyright © 2020 IEEE. All rights reserved.

Contents

1. Overview 10
1.3 Introduction 10

2. Normative references 11

3. Definitions 12

4. Acronyms and abbreviations 13

5. Conformance 14
5.3 Bridge requirements 14
5.4 Bridge options 14
5.6 End station options 15

6. Fronthaul 16
6.1 Radio access technology background 16
6.2 Class 1 requirements 16
6.3 Class 2 requirements 17
6.4 Synchronization requirements 19

7. Bridge and synchronization functions 23
7.3 Frame preemption 23
7.4 Network synchronization 23

8. Fronthaul profiles 25
8.1 Profile A 25
8.2 Profile B 26

9. Synchronization solutions 27
9.1 Solutions for Category A 27

Annex A (normative) PCS proforma—Time-sensitive networking for Fronthaul Profiles 28

Annex C (informative) Fronthaul interfaces 32

Annex D (informative) Bibliography 33

Copyright © 2020 IEEE. All rights reserved.

IEEE Standard for
Local and metropolitan area networks—

Time-Sensitive Networking for Fronthaul

Amendment 1: Enhancements to Fronthaul Profiles to Support New Fronthaul Interface, Synchronization, and Syntonization Standards

The amendment is based on IEEE Std 802.1CM-2018.

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.

The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strikethrough~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Deletions and insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editing instructions, change markings, and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.[1]

1. Overview

1.3 Introduction

Change the dashed list of the second paragraph in 1.3 as shown (text of footnote 3 remains unchanged):

- Virtual Local Area Network (VLAN) Bridge specification in IEEE Std 802.1Q™.[3]
- MAC service specifications in IEEE Std 802.1AC™.
- MAC/PHY technology specifications in IEEE Std 802.3™.
- Interspersing express traffic specification in IEEE Std 802.3~~br~~™.
- Frame preemption specification in IEEE Std 802.1Q.
- Time synchronization and Precision Time Protocol (PTP) specifications in IEEE Std 1588™.
- Telecom profile specification in ITU-T G.8275.1, which is based on IEEE Std 1588.
- Synchronous Ethernet specification in ITU-T G.8261, G.8262, G.8262.1, and G.8264.

[1] Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

Copyright © 2020 IEEE. All rights reserved.

2. Normative references

Delete* IEEE Std 802.3br™ *("IEEE ... Ethernet—Amendment 5: ....") from the list of normative references in Clause 2.

Change the following references in Clause 2 as shown (text of footnote 7 remains unchanged):

ITU-T G.8262, Timing characteristics of a synchronous ~~Ethernet~~ equipment slave clock.

MEF 10.~~3~~4, Subscriber Ethernet Service Attributes ~~Phase 3~~.[7]

Insert the following reference into Clause 2 in alphanumeric order:

ITU-T G.8262.1, Timing characteristics of an enhanced synchronous equipment slave clock.

Copyright © 2020 IEEE. All rights reserved.

3. Definitions

Change the following definition and footnote in Clause 3 as shown:

Synchronous Ethernet: A method to distribute frequency synchronization over the Ethernet physical layer according to IEEE Std 802.3 and ITU-T Recommendations G.8261, G.8262, G.8262.1, and G.8264.[10]

[10] Synchronous Ethernet has been defined to be fully conformant to IEEE Std 802.3 as documented in the relevant ITU-T Recommendations (G.8261, G.8262, G.8262.1, and G.8264).

Copyright © 2020 IEEE. All rights reserved.