INTERNATIONAL STANDARD

ISO/IEC/IEEE 8802-1CM

First edition
2019-07

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

Part 1CM: Time-sensitive networking for fronthaul

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

Partie 1CM: Réseaux à temps critique pour fronthaul

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

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IEEE Std 802.1CM™-2018

IEEE Standard for
Local and metropolitan area networks—

Time-Sensitive Networking for Fronthaul

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LAN/MAN Standards Committee
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Approved 7 May 2018

IEEE-SA Standards Board

Abstract: This standard defines profiles that select features, options, configurations, defaults, protocols, and procedures of bridges, stations, and LANs that are necessary to build networks that are capable of transporting fronthaul streams, which are time sensitive.

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

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Print: ISBN 978-1-5044-4909-0 STD23131
PDF: ISBN 978-1-5044-4910-6 STDPD23131

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Introduction

This introduction is not part of IEEE Std 802.1CM-2018, IEEE Standard for Local and metropolitan area networks—Time-Sensitive Networking for Fronthaul.

This standard defines profiles that select features, options, configurations, defaults, protocols and procedures of bridges, stations, and LANs that are necessary to build networks that are capable of transporting fronthaul streams, which are time-sensitive.

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IEEE Standard for
Local and metropolitan area networks—

Time-Sensitive Networking for Fronthaul

1. Overview

1.1 Scope

This standard defines profiles that select features, options, configurations, defaults, protocols and procedures of bridges, stations, and LANs that are necessary to build networks that are capable of transporting fronthaul streams, which are time-sensitive.

NOTE—Stream and flow are used as synonyms in this document.[1]

1.2 Purpose

The purpose of this standard is to specify defaults and profiles that enable the transport of time-sensitive fronthaul streams in Ethernet bridged networks.

1.3 Introduction

Fronthaul provides connectivity between functional blocks of a cellular base station (BS). The fronthaul flows between these functional blocks have stringent quality of service requirements. The successful support of fronthaul flows in a bridged network requires the selection of specific features and options that are specified in a number of different standards, some developed by IEEE Project 802®, and others (in particular, those that relate to functionality in OSI layer 3 and above; ISO/IEC 7498:1994 [B11]) developed by other standards organizations.[2]

This standard selects features and options that support OSI layers 1 and 2 in bridges and end stations from the following specifications:

— Virtual Local Area Network (VLAN) Bridge specification in IEEE Std 802.1Q™.[3]
— MAC service specifications in IEEE Std 802.1AC™.

[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.
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[3]Information on references can be found in Clause 2.

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— MAC/PHY technology specifications in IEEE Std 802.3™.
— Interspersing express traffic specification in IEEE Std 802.3br™.
— 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, and G.8264.

To specify and explain the selection of features and options, this standard:

a) Describes fronthaul requirements (Clause 6), specifying two classes of requirements (6.2, 6.3) that depend on the BS functional decomposition, and specifying synchronization requirements (6.4) that apply to both classes.
b) Describes how the operation of bridges and bridged networks affects the quality of service provided by the fronthaul bridged network (Clause 7), providing details to assist in the calculation of latency (7.1, 7.2, 7.3), the selection of network synchronization methods (7.4), and the potential impact of the use of flow control (7.5) and Energy Efficient Ethernet (EEE, 7.6).
c) Specifies two bridge profiles (Clause 8) that support the construction of bridged networks meeting fronthaul requirements. Profile A (8.1) is applicable to bridges that do not support frame preemption (7.3), while Profile B (8.2) involves frame preemption to accommodate larger non-fronthaul flows and frame sizes while preserving fronthaul traffic guarantees.
d) Discusses the applicability (Clause 9) of the synchronization methods described in 7.4 to the time synchronization categories defined in 6.4.1.
e) Defines fronthaul profile conformance requirements (Clause 5) for bridges meeting either Profile A or Profile B requirements, for end stations and for synchronization.
f) Provides a Profile Conformance Statement (PCS, Annex A) to support clear detailed statements of equipment conformance to fronthaul profile requirements.

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2. Normative references

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IEEE Std 802®, IEEE Standard for Local and Metropolitan Area Networks—Overview and Architecture.[4, 5]

IEEE Std 802.1AC™, IEEE Standard for Local and Metropolitan Area Networks—Media Access Control (MAC) Service Definition.

IEEE Std 802.1Q™, IEEE Standard for Local and Metropolitan Area Networks—Bridges and Bridged Networks.

IEEE Std 802.3™, IEEE Standard for Ethernet.

IEEE Std 802.3br™, IEEE Standard for Ethernet—Amendment 5: Specification and Management Parameters for Interspersing Express Traffic.

IEEE Std 1588™, IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.

ITU-T G.8261, Timing and synchronization aspects in packet networks.[6]

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

ITU-T G.8264, Distribution of timing information through packet networks.

ITU-T G.8271.1, Network limits for time synchronization in packet networks.

ITU-T G.8272, Timing characteristics of primary reference time clocks.

ITU-T G.8272.1, Timing characteristics of enhanced primary reference time clocks.

ITU-T G.8273.2, Timing characteristics of telecom boundary clocks and telecom time slave clocks.

ITU-T G.8273.3, Timing characteristics of telecom transparent clocks.

ITU-T G.8275.1, Precision time protocol telecom profile for phase/time synchronization with full timing support from the network.

MEF 10.3, Ethernet Services Attributes Phase 3.[7]

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3. Definitions

For the purposes of this document, the following terms and definitions apply. *The IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.[8]

This standard makes use of the following terms defined in IEEE Std 802:

— bridge
— end station
— Ethernet
— forwarding
— frame
— Local Area Network (LAN)

This standard makes use of the following terms defined in IEEE Std 802.1Q:

— bridged network
— latency
— port
— priority-tagged frame
— traffic class
— untagged frame
— Virtual Local Area Network (VLAN)
— VLAN Bridge
— VLAN-tagged frame

The following terms are specific to this standard:

Category: An identifier of time synchronization requirements.[9]

NOTE—See 6.4.1.

Class: A collective term for fronthaul interfaces that applies a particular functional decomposition of a cellular base station and a particular treatment of fronthaul information flows.

NOTE—See 6.2 and 6.3.

fronthaul: The connectivity between the functional blocks (e.g., baseband processing and radio frequency blocks) of a cellular base station.

periodic: Repeating continuously, with a constant time (the period) between each occurrence.

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.8264.[10]

time window: A time interval (among back-to-back time intervals of the same duration), within which packets of a specified flow can be sent.

[8]IEEE Standards Dictionary Online is available at: http://dictionary.ieee.org.

[9]The Categories used in this standard are defined by the Requirements for the eCPRI Transport Network [B6].

[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.8264.

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