

INTERNATIONAL  
STANDARD

ISO/IEC/  
IEEE  
8802-3

Second edition  
2017-03-01

AMENDMENT 5  
2017-11

---

---

**Information technology —  
Telecommunications and information  
exchange between systems — Local  
and metropolitan area networks —  
Specific requirements —**

**Part 3:  
Standard for Ethernet**

**AMENDMENT 5: Specification  
and management parameters for  
interspersing express traffic**

*Technologies de l'information — Télécommunications et échange  
d'information entre systèmes — Réseaux locaux et métropolitains —  
Prescriptions spécifiques —*

*Partie 3: Norme pour Ethernet*

*AMENDEMENT 5: Spécification et paramètres de gestion en vue de  
l'insertion en trafic express*



Reference number  
ISO/IEC/IEEE 8802-3:2017/Amd.5:2017(E)

© IEEE 2016



**COPYRIGHT PROTECTED DOCUMENT**

© IEEE 2016

All rights reserved. Unless otherwise specified, 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 either ISO or IEEE at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
copyright@iso.org  
www.iso.org

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

stds.ipr@ieee.org  
www.ieee.org

## 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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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.

The main task of ISO/IEC JTC 1 is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is called to the possibility that implementation of this standard may require the use of subject matter covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. ISO/IEEE is not responsible for identifying essential patents or patent claims for which a license may be required, for conducting inquiries into the legal validity or scope of patents or patent claims or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance or a Patent Statement and Licensing Declaration Form, 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 ISO or the IEEE Standards Association.

ISO/IEC/IEEE 8802-3:2017/Amd.5 was prepared by the LAN/MAN of the IEEE Computer Society (as IEEE STD 802.3br-2016). It was adopted by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*, in parallel with its approval by the ISO/IEC national bodies, under the “fast-track procedure” defined in the Partner Standards Development Organization cooperation agreement between ISO and IEEE. IEEE is responsible for the maintenance of this document with participation and input from ISO/IEC national bodies.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC/IEEE 8802-3:2017/AMD5:2017

**IEEE Std 802.3br™-2016**

(Amendment to  
IEEE Std 802.3™-2015  
as amended by  
IEEE Std 802.3bw™-2015,  
IEEE Std 802.3by™-2016,  
IEEE Std 802.3bq™-2016, and  
IEEE Std 802.3bp™-2016)

# IEEE Standard for Ethernet

## Amendment 5: Specification and Management Parameters for Interspersing Express Traffic

Sponsor

**LAN/MAN Standards Committee  
of the  
IEEE Computer Society**

Approved 30 June 2016

**IEEE-SA Standards Board**

STANDARDSISO.COM :: Click to view the full PDF of ISO/IEC/IEEE 802-3:2017/AMD5:2017

**Abstract:** This amendment to IEEE Std 802.3-2015 specifies additions to and appropriate modifications to add support for interspersing express traffic over a single physical link.

**Keywords:** Ethernet, express traffic, IEEE 802<sup>®</sup>, IEEE 802.3<sup>™</sup>, IEEE 802.3br<sup>™</sup>, preemption

---

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

Copyright © 2016 by The Institute of Electrical and Electronics Engineers, Inc.  
All rights reserved. Published 14 October 2016. Printed in the United States of America.

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

Print: ISBN 978-1-5044-2335-9 STD21119  
PDF: ISBN 978-1-5044-2336-6 STDPD21119

*IEEE prohibits discrimination, harassment, and bullying.*

For more information, visit <http://www.ieee.org/web/aboutus/whatis/policies/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 documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Standards Documents.”

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

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (“IEEE-SA”) Standards Board. IEEE (“the Institute”) develops its standards through a consensus development process, approved by the American National Standards Institute (“ANSI”), which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute 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 content 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. 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: PROCUREMENT OF 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 should be considered the approved IEEE standard.

## 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, or 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 his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

## Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide 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 revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

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

## 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 imply 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.

## Copyrights

IEEE draft and approved standards are copyrighted by IEEE under U.S. 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 fee, 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. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

## 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 ten years. When a document is more than ten 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 the IEEE-SA Website at <http://ieeexplore.ieee.org/Xplore/home.jsp> or contact IEEE at the address listed previously. For more information about the IEEE-SA or IEEE's standards development process, visit the IEEE-SA Website at <http://standards.ieee.org>.

## Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: <http://standards.ieee.org/findstds/errata/index.html>. Users are encouraged to check this URL for errata periodically.

## Patents

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 <http://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.

## Participants

The following individuals were officers and members of the IEEE 802.3 Working Group at the beginning of the IEEE P802.3br Working Group ballot. Individuals may have not voted, voted for approval, disapproval or abstained on this standard.

**David J. Law**, *IEEE 802.3 Working Group Chair*

**Adam Healey**, *IEEE 802.3 Working Group Vice Chair*

**Peter Anslow**, *IEEE 802.3 Working Group Secretary*

**Steven B. Carlson**, *IEEE 802.3 Working Group Executive Secretary*

**Valerie Maguire**, *IEEE 802.3 Working Group Treasurer*

**Ludwig Winkel**, *IEEE P802.3br Interspersing Express Traffic Task Force Chair*

**Patricia Thaler**, *IEEE P802.3br Interspersing Express Traffic Task Force Editor-in-Chief*

|                           |                   |                     |
|---------------------------|-------------------|---------------------|
| John Abbott               | Keith Conroy      | Thomas Hogenmueller |
| David Abramson            | Eugene Dai        | Brjan Holden        |
| Shadi Abughazaleh         | Shaoan Dai        | Rita Horner         |
| Faisal Ahmad              | John D' Ambrosia  | Bernd Hormmeyer     |
| Dale Amason               | Mike Darling      | Victor Hou          |
| J. Michael Andrewartha    | Yair Darshan      | Rui Hua             |
| Oleksandr Babenko         | Piers Dawe        | Liang-wei Huang     |
| Kwang-Hyun Baek           | Fred Dawson       | Scott Irwin         |
| Amrik Bains               | Ian Dedic         | Kazuhiko Ishibe     |
| Koussalya Balasubramanian | Chris Diminico    | Hideki Isono        |
| Thananya Baldwin          | Thuyen Dinh       | Tom Issenhuth       |
| Denis Beaudoin            | Curtis Donahue    | Kenneth Jackson     |
| Christian Beia            | Dan Dove          | Jack Jewell         |
| Yakov Belopolsky          | Mike Dudek        | Wenbin Jiang        |
| Michael Bennett           | David Dwelley     | Andrew Jimenez      |
| Vipul Bhatt               | Hesham Elbakoury  | Chad Jones          |
| William Bliss             | David Estes       | Antony Joseph       |
| Brad Booth                | John Ewen         | Yasuaki Kawatsu     |
| Martin Bouda              | Josef Faller      | Michael Kelsen      |
| David Brandt              | Shahar Feldman    | Yongbum Kim         |
| Ralf-Peter Braun          | German Feyh       | Jonathan King       |
| Theodore Brillhart        | Alan Flatman      | Scott Kipp          |
| Paul Brooks               | Howard Frazier    | Michael Klempa      |
| David Brown               | Richard Frosch    | Avi Kliger          |
| Matthew Brown             | Michael Furlong   | Curtis Knittle      |
| Thomas Brown              | Andrew Gardner    | Shigeru Kobayashi   |
| Phillip Brownlee          | Mike Gardner      | Keisuke Kojima      |
| Mark Bugg                 | Ali Ghiasi        | Paul Kolesar        |
| Juan-Carlos Calderon      | Joel Goergen      | Tom Kolze           |
| J. Martin Carroll         | Zhigang Gong      | Glen Kramer         |
| Clark Carty               | Steven Gorshe     | Albert Kuo          |
| Mandeep Chadha            | James Graba       | Hans Lackner        |
| David Chalupsky           | Robert Grow       | Efstathios Larios   |
| Jacky Chang               | Mark Gustlin      | Wayne Larsen        |
| Xin Chang                 | Marek Hajduczenia | Mark Laubach        |
| David Chen                | Bernie Hammond    | Greg Le Cheminant   |
| Wheling Cheng             | Jeffrey Heath     | Arthur Lee          |
| Ahmad Chini               | Carl Herman       | David Lewis         |
| Golam Choudhury           | David Hess        | Lei Li              |
| Peter Cibula              | Yasuo Hidaka      | Mike Peng Li        |
| Christopher R. Cole       | Riu Hirai         | Shaohua Li          |

|                              |                         |                     |
|------------------------------|-------------------------|---------------------|
| Thomas Lichtenegger          | Michael Peters          | Takayuki Tajima     |
| Ru Jian Lin                  | John Petrilla           | Tomoo Takahara      |
| Robert Lingle                | Rick Pimpinella         | Satoshi Takahashi   |
| James Liu                    | Neven Pischl            | Kiyoto Takahata     |
| Zhenyu Liu                   | Rainer Poehmerer        | Alexander Tan       |
| William Lo                   | William Powell          | Toshiki Tanaka      |
| Miklos Lukacs                | Richard Prodan          | Mehmet Tazebay      |
| Kent Lusted                  | Rick Rabinovich         | Brian Teipen        |
| Jeffery Maki                 | Saifur Rahman           | Geoffrey Thompson   |
| James Malkemus               | Adee Ran                | Alan Tipper         |
| Yonatan Malkiman             | Ram Rao                 | Pirooz Tooyserkani  |
| Edwin Mallette               | Alon Regev              | Nathan Tracy        |
| Arthur Marris                | Duane Remein            | David Tremblay      |
| Chris Mash                   | Victor Renteria         | Albert Tretter      |
| Kirsten Matheus              | Michael Ressler         | Stephen Trowbridge  |
| Erdem Matoglu                | Poldi (Pavlick) Rimboim | Wen-Cheng Tseng     |
| Laurence Matola              | Christopher Roth        | Yoshihiro Tsukamoto |
| Brett McClellan              | Salvatore Rotolo        | Mike Tu             |
| Thomas McDermott             | Hisaya Sakamoto         | Alan Ugolini        |
| John McDonough               | Vineet Salunke          | John Ulm            |
| Richard Mei                  | Sam Sambasivan          | Ed Ulrichs          |
| Richard Mellitz              | Yasuo Sasaki            | Sterling A. Vaden   |
| Bryan Moffitt                | Fred Schindler          | Stefano Valle       |
| Leo Montreuil                | Stefan Schneelee        | Paul Vanderlaan     |
| Paul Mooney                  | Peter Scruton           | Robert Wagner       |
| Charles Moore                | Alexander Seiger        | Robert Wang         |
| Andy Moorwood                | Naoshi Serizawa         | Tongtong Wang       |
| Thomas Mueller               | Megha Shanbhag          | Xiaofeng Wang       |
| Ron Muir                     | Masood Shariff          | Xinyuan Wang        |
| Dale Murray                  | Stephen Shelhammer      | Zhong Feng Wang     |
| Henry Muyschondt             | Bazhong Shen            | Markus Weber        |
| Edward Nakamoto              | Mizuki Shirao           | Brian Welch         |
| Gary Nicholl                 | Kapil Shrikhande        | Yang Wen            |
| Paul Nikolich                | Jeff Slavick            | Matthias Wendt      |
| Kevin Noll                   | Scott Sommers           | Oded Wertheim       |
| Ronald Nordin                | Yoshiaki Sone           | Natalie Wienckowski |
| Mark Nowell                  | Xiaolu Song             | Peter Wu            |
| David Ofelt                  | Tom Souvignier          | Yu Xu               |
| Ichiro Ogura                 | Bryan Sparrowhawk       | Lennart Yseboodt    |
| Tom Palkert                  | Edward Sprague          | Liquan Yuan         |
| Sujan Pandey                 | Peter Stassar           | Hayato Yuki         |
| Sesha Panguluri              | Leonard Stencil         | Garold Yurko        |
| Carlos Pardo                 | Robert Stone            | Andrew Zambell      |
| Moon Park                    | Steve Swanson           | Jin Zhang           |
| Pravin Patel                 | Andre Szczepanek        | Yan Zhuang          |
| Petar Pepeljugoski           | William Szeto           | George Zimmerman    |
| Gerald Pepper                | Bharat Tailor           | Helge Zinner        |
| Ruben Perez De Aranda Alonso | Akio Tajima             | Pavel Zivny         |
|                              |                         | Gaoling Zou         |

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

|                      |                      |                              |
|----------------------|----------------------|------------------------------|
| Thomas Alexander     | David Hess           | Satoshi Obara                |
| Richard Alfvén       | Werner Hoelzl        | Satoshi Oyama                |
| Dale Amason          | Rita Horner          | Arumugam Paventhan           |
| Peter Anslow         | Victor Hou           | Ruben Perez De Aranda Alonso |
| Butch Anton          | Noriyuki Ikeuchi     | Michael Peters               |
| Stefan Aust          | Sergiu Iordanescu    | Adee Ran                     |
| Eric Baden           | Osamu Ishida         | R. K. Rannow                 |
| Amrik Bains          | Atsushi Ito          | Alon Regev                   |
| Michael Bennett      | Raj Jain             | Duane Remein                 |
| Gennaro Boggia       | Anthony Jeffree      | Maximilian Riegel            |
| Christian Boiger     | Michael Johas Teener | Robert Robinson              |
| Ralf-Peter Braun     | Peter Jones          | Benjamin Rolfe               |
| Nancy Bravin         | Adri Jovin           | Dan Romascanu                |
| Theodore Brillhart   | Piotr Karocki        | Bartien Sayogo               |
| Jairo Bustos Heredia | Stuart Kerry         | Frank Schewe                 |
| William Byrd         | Yongbum Kim          | Dieter Schicketanz           |
| Steven B. Carlson    | Jonathan King        | Stefan Schmeele              |
| Juan Carreon         | Scott Kipp           | Michael Seaman               |
| Mandeep Chadha       | Jouni Korhonen       | Shusaku Shimada              |
| Minho Cheong         | Bruce Kraemer        | Ju-Hyung Son                 |
| Keith Chow           | Mark Laubach         | Thomas Starai                |
| Keng Hua Chuang      | David J. Law         | Peter Stassar                |
| Charles Cook         | David Lewis          | Eugene Stoudenmire           |
| Rodney Cummings      | Jon Lewis            | Walter Struppler             |
| Sourav Dutta         | Arthur H. Light      | Mitsutoshi Sugawara          |
| Janos Farkas         | William Lo           | Patricia Thaler              |
| German Feyh          | Michael Lynch        | Mark-Rene Uchida             |
| Norman Finn          | Elvis Maculúba       | Lorenzo Vangelista           |
| Matthias Fritsche    | Valerie Maguire      | Dmitri Varsanofiev           |
| Yukihiro Fujimoto    | Jeffery Maki         | Prabodh Varshney             |
| Eric W. Gray         | Arthur Marris        | George Vlantis               |
| David Gregson        | Brett McClellan      | Stephen Webb                 |
| Randall Groves       | Thomas Mcdermott     | Hung-Yu Wei                  |
| Craig Gunther        | Richard Mellitz      | Ludwig Winkel                |
| Stephen Haddock      | John Messenger       | Andreas Wolf                 |
| Marek Hajduczenia    | Bryan Moffitt        | Peter Wu                     |
| Mark Hantel          | Charles Moorwood     | Oren Yuen                    |
| Adam Healey          | Shimon Muller        | Andrew Zambell               |
| Jerome Henry         | Michael Newman       | Zhen Zhou                    |
| Marco Hernandez      | Nick S. A. Nikjoo    |                              |

When the IEEE-SA Standards Board approved this standard on 30 June 2016, it had the following membership:

**Jean-Philippe Faure**, *Chair*  
**Ted Burse**, *Vice Chair*  
**John D. Kulick**, *Past Chair*  
**Konstantinos Karachalios**, *Secretary*

Chuck Adams  
Masayuki Ariyoshi  
Stephen Dukes  
Jianbin Fan  
Ronald W. Hotchkiss  
J. Travis Griffith

Gary Hoffman  
Michael Janezic  
Joseph L. Koepfinger\*  
Hung Ling  
Kevin Lu  
Gary Robinson  
Annette D. Reilly

Mehmet Ulema  
Yingli Wen  
Howard Wolfman  
Don Wright  
Yu Yuan  
Daidi Zhong

\*Member Emeritus

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC/IEEE 8802-3:2017/Amd5:2017

## Introduction

This introduction is not part of IEEE Std 802.3br™-2016, IEEE Standard for Ethernet—Amendment 5: Specification and Management Parameters for Interspersing Express Traffic.

IEEE Std 802.3 was first published in 1985. Since the initial publication, many projects have added functionality or provided maintenance updates to the specifications and text included in the standard. Each IEEE 802.3 project/amendment is identified with a suffix (e.g., IEEE Std 802.3ba™-2010).

The half-duplex Media Access Control (MAC) protocol specified in IEEE Std 802.3-1985 is Carrier Sense Multiple Access with Collision Detection (CSMA/CD). This MAC protocol was key to the experimental Ethernet developed at Xerox Palo Alto Research Center, which had a 2.94 Mb/s data rate. Ethernet at 10 Mb/s was jointly released as a public specification by Digital Equipment Corporation (DEC), Intel, and Xerox in 1980. Ethernet at 10 Mb/s was approved as an IEEE standard by the IEEE Standards Board in 1983 and subsequently published in 1985 as IEEE Std 802.3-1985. Since 1985, new media options, new speeds of operation, and new capabilities have been added to IEEE Std 802.3. A full duplex MAC protocol was added in 1997.

Some of the major additions to IEEE Std 802.3 are identified in the marketplace with their project number. This is most common for projects adding higher speeds of operation or new protocols. For example, IEEE Std 802.3u™ added 100 Mb/s operation (also called Fast Ethernet), IEEE Std 802.3z™ added 1000 Mb/s operation (also called Gigabit Ethernet), IEEE Std 802.3ae™ added 10 Gb/s operation (also called 10 Gigabit Ethernet), IEEE Std 802.3ah™ specified access network Ethernet (also called Ethernet in the First Mile), and IEEE Std 802.3ba added 40 Gb/s operation (also called 40 Gigabit Ethernet) and 100 Gb/s operation (also called 100 Gigabit Ethernet). These major additions are all now included in and are superseded by IEEE Std 802.3-2015 and are not maintained as separate documents.

At the date of IEEE Std 802.3br-2016 publication, IEEE Std 802.3 is composed of the following documents:

### IEEE Std 802.3-2015

Section One—Includes Clause 1 through Clause 20 and Annex A through Annex H and Annex 4A. Section One includes the specifications for 10 Mb/s operation and the MAC, frame formats, and service interfaces used for all speeds of operation.

Section Two—Includes Clause 21 through Clause 33 and Annex 22A through Annex 33E. Section Two includes management attributes for multiple protocols and speed of operation as well as specifications for providing power over twisted-pair cabling for multiple operational speeds. It also includes general information on 100 Mb/s operation as well as most of the 100 Mb/s Physical Layer specifications.

Section Three—Includes Clause 34 through Clause 43 and Annex 36A through Annex 43C. Section Three includes general information on 1000 Mb/s operation as well as most of the 1000 Mb/s Physical Layer specifications.

Section Four—Includes Clause 44 through Clause 55 and Annex 44A through Annex 55B. Section Four includes general information on 10 Gb/s operation as well as most of the 10 Gb/s Physical Layer specifications.

Section Five—Includes Clause 56 through Clause 77 and Annex 57A through Annex 76A. Clause 56 through Clause 67 and Clause 75 through Clause 77, as well as associated annexes, specify subscriber access and other Physical Layers and sublayers for operation from 512 kb/s to 10 Gb/s, and defines

services and protocol elements that enable the exchange of IEEE 802.3 format frames between stations in a subscriber access network. Clause 68 specifies a 10 Gb/s Physical Layer specification. Clause 69 through Clause 74 and associated annexes specify Ethernet operation over electrical backplanes at speeds of 1000 Mb/s and 10 Gb/s.

Section Six—Includes Clause 78 through Clause 95 and Annex 83A through Annex 93C. Clause 78 specifies Energy-Efficient Ethernet. Clause 79 specifies IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and value (TLV) information elements. Clause 80 through Clause 95 and associated annexes include general information on 40 Gb/s and 100 Gb/s operation as well the 40 Gb/s and 100 Gb/s Physical Layer specifications. Clause 90 specifies Ethernet support for time synchronization protocols.

#### IEEE Std 802.3bw-2015

Amendment 1—This amendment includes changes to IEEE Std 802.3-2015 and adds Clause 96. This amendment adds 100 Mb/s Physical Layer (PHY) specifications and management parameters for operation on a single balanced twisted-pair copper cable.

#### IEEE Std 802.3by-2016

Amendment 2—This amendment includes changes to IEEE Std 802.3-2015 and adds Clause 105 through Clause 112, Annex 109A, Annex 109B, Annex 109C, Annex 110A, Annex 110B, and Annex 110C. This amendment adds MAC parameters, Physical Layers, and management parameters for the transfer of IEEE 802.3 format frames at 25 Gb/s.

#### IEEE Std 802.3bq-2016

Amendment 3—This amendment includes changes to IEEE Std 802.3-2015 and adds Clause 113 and Annex 113A. This amendment adds new Physical Layers for 25 Gb/s and 40 Gb/s operation over balanced twisted-pair structured cabling systems.

#### IEEE Std 802.3bp-2016

Amendment 4—This amendment includes changes to IEEE Std 802.3-2015 and adds Clause 97 and Clause 98. This amendment adds point-to-point 1 Gb/s Physical Layer (PHY) specifications and management parameters for operation on a single balanced twisted-pair copper cable in automotive and other applications not utilizing the structured wiring plant.

#### IEEE Std 802.3br-2016

Amendment 5—This amendment includes changes to IEEE Std 802.3-2015 and adds Clause 99. This amendment adds a MAC Merge sublayer and a MAC Merge Service Interface to support for Interspersing Express Traffic over a single link.

A companion document IEEE Std 802.3.1 describes Ethernet management information base (MIB) modules for use with the Simple Network Management Protocol (SNMP). IEEE Std 802.3.1 is updated to add management capability for enhancements to IEEE Std 802.3 after approval of the enhancements.

IEEE Std 802.3 will continue to evolve. New Ethernet capabilities are anticipated to be added within the next few years as amendments to this standard.

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC/IEEE 8802-3:2017/AMD5:2017

## Contents

|              |  |    |
|--------------|--|----|
| 1.           | Introduction.....  | 17 |
| 1.4          | Definitions .....  | 17 |
| 1.5          | Abbreviations.....   | 17 |
| 30.          | Management.....  | 18 |
| 30.2         | Managed objects .....  | 18 |
| 30.2.2       | Overview of managed objects .....  | 18 |
| 30.2.2.1     | Text description of managed objects.....   | 18 |
| 30.2.3       | Containment .....  | 18 |
| 30.2.5       | Capabilities.....  | 20 |
| 30.12        | Layer Management for Link Layer Discovery Protocol (LLDP).....   | 21 |
| 30.12.1      | LLDP Configuration managed object class.....   | 21 |
| 30.12.1.1    | LLDP Configuration attributes.....   | 21 |
| 30.12.1.1.1  | aLldpXdot3PortConfigTLVsTxEnable .....   | 21 |
| 30.12.2      | LLDP Local System Group managed object class .....   | 22 |
| 30.12.2.1    | LLDP Local System Group attributes.....  | 22 |
| 30.12.2.1.34 | aLldpXdot3LocPreemptSupported .....  | 22 |
| 30.12.2.1.35 | aLldpXdot3LocPreemptEnabled .....  | 22 |
| 30.12.2.1.36 | aLldpXdot3LocPreemptActive.....  | 22 |
| 30.12.2.1.37 | aLldpXdot3LocAddFragSize.....  | 23 |
| 30.12.3      | LLDP Remote System Group managed object class.....   | 23 |
| 30.12.3.1    | LLDP Remote System Group attributes.....   | 23 |
| 30.12.3.1.28 | aLldpXdot3RemPreemptSupported.....   | 23 |
| 30.12.3.1.29 | aLldpXdot3RemPreemptEnabled .....  | 23 |
| 30.12.3.1.30 | aLldpXdot3RemPreemptActive .....   | 23 |
| 30.12.3.1.31 | aLldpXdot3RemAddFragSize .....   | 23 |
| 30.14        | Management for MAC Merge Sublayer .....  | 24 |
| 30.14.1      | oMACMergeEntity managed object class.....  | 24 |
| 30.14.1.1    | aMACMergeSupport .....   | 24 |
| 30.14.1.2    | aMACMergeStatusVerify .....  | 24 |
| 30.14.1.3    | aMACMergeEnableTx .....  | 24 |
| 30.14.1.4    | aMACMergeVerifyDisableTx .....   | 25 |
| 30.14.1.5    | aMACMergeStatusTx .....  | 25 |
| 30.14.1.6    | aMACMergeVerifyTime.....   | 25 |
| 30.14.1.7    | aMACMergeAddFragSize .....   | 25 |
| 30.14.1.8    | aMACMergeFrameAssErrorCount .....  | 26 |
| 30.14.1.9    | aMACMergeFrameSmdErrorCount.....   | 26 |
| 30.14.1.10   | aMACMergeFrameAssOkCount.....  | 26 |
| 30.14.1.11   | aMACMergeFragCountRx.....  | 26 |
| 30.14.1.12   | aMACMergeFragCountTx.....  | 27 |
| 30.14.1.13   | aMACMergeHoldCount.....  | 27 |
| 79.          | IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and value (TLV) information elements ..... | 28 |
| 79.3         | IEEE 802.3 Organizationally Specific TLVs .....  | 28 |
| 79.3.7       | Additional Ethernet Capabilities TLV.....  | 28 |
| 79.3.7.1     | Additional Ethernet capabilities .....   | 28 |
| 79.3.7.2     | Additional Ethernet Capabilities TLV usage rules .....   | 28 |

|            |   |    |
|------------|---|----|
| 79.4       | IEEE 802.3 Organizationally Specific TLV selection management .....   | 29 |
| 79.4.2     | IEEE 802.3 Organizationally Specific TLV/LLDP Local and Remote System group managed object class cross references.....  | 29 |
| 79.5       | Protocol implementation conformance statement (PICS) proforma for IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and value (TLV) information elements..... | 31 |
| 79.5.3     | Major capabilities/options .....  | 31 |
| 79.5.11    | Additional Ethernet Capabilities TLV.....   | 31 |
| 90.        | Ethernet support for time synchronization protocols.....  | 32 |
| 90.4       | Time Synchronization Service Interface (TSSI).....  | 32 |
| 90.4.3     | Detailed service specification.....   | 32 |
| 90.4.3.1   | TS_TX.indication primitive .....  | 32 |
| 90.4.3.1.1 | Semantics.....  | 32 |
| 90.4.3.2   | TS_RX.indication primitive .....  | 32 |
| 90.4.3.2.1 | Semantics.....  | 32 |
| 90.5       | generic Reconciliation Sublayer (gRS).....  | 32 |
| 90.5.1     | TS_SFD_Detect_TX function .....   | 33 |
| 90.5.2     | TS_SFD_Detect_RX function.....  | 33 |
| 90.8       | Protocol implementation conformance statement (PICS) proforma for Clause 90, Ethernet support for time synchronization protocols.....   | 34 |
| 90.8.3     | TSSI indication.....  | 34 |
| 99.        | MAC Merge sublayer .....  | 35 |
| 99.1       | Introduction.....   | 35 |
| 99.1.1     | Relationship to other IEEE standards.....   | 36 |
| 99.1.2     | Functional Block Diagram.....   | 38 |
| 99.2       | MAC Merge Service Interface (MMSI) .....  | 38 |
| 99.2.1     | MM_CTL.request.....   | 38 |
| 99.2.1.1   | Semantics .....   | 39 |
| 99.2.1.2   | When generated.....   | 39 |
| 99.2.1.3   | Effect of receipt.....  | 39 |
| 99.3       | MAC Merge Packet (mPacket).....   | 39 |
| 99.3.1     | mPacket format.....   | 39 |
| 99.3.2     | Preamble.....   | 39 |
| 99.3.3     | Start mPacket Delimiter (SMD) .....   | 40 |
| 99.3.4     | frag_count.....   | 40 |
| 99.3.5     | mData .....   | 41 |
| 99.3.6     | CRC.....  | 41 |
| 99.4       | MAC Merge sublayer operation .....  | 42 |
| 99.4.1     | MAC Merge sublayer transmit behavior when preemption is disabled.....   | 42 |
| 99.4.2     | Determining that the link partner supports preemption.....  | 42 |
| 99.4.3     | Verifying preemption operation .....  | 42 |
| 99.4.4     | Transmit processing.....  | 43 |
| 99.4.5     | Receive processing .....  | 43 |
| 99.4.6     | Express filter.....   | 44 |
| 99.4.7     | Detailed functions and state diagrams.....  | 45 |
| 99.4.7.1   | State diagram conventions .....   | 45 |
| 99.4.7.2   | Constants .....   | 45 |
| 99.4.7.3   | Variables.....  | 45 |
| 99.4.7.4   | Functions .....   | 47 |
| 99.4.7.5   | Counters .....  | 49 |

|          |  |    |
|----------|--|----|
| 99.4.7.6 | Timers.....  | 49 |
| 99.4.7.7 | State diagrams .....   | 49 |
| 99.4.8   | Delay Constraints .....  | 52 |
| 99.5     | Protocol implementation conformance statement (PICS) proforma for Clause 99,<br>MAC Merge sublayer ..... | 54 |
| 99.5.1   | Introduction .....   | 54 |
| 99.5.2   | Identification.....  | 54 |
| 99.5.2.1 | Implementation identification .....  | 54 |
| 99.5.2.2 | Protocol summary .....   | 54 |
| 99.5.3   | PICS proforma tables for MAC Merge sublayer.....   | 55 |
| 99.5.3.1 | Functional specifications.....   | 55 |
| 99.5.3.2 | Delay constraints.....   | 56 |

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC/IEEE 8802-3:2017/Amd5:2017

# IEEE Standard for Ethernet

## Amendment 5: Specification and Management Parameters for Interspersing Express Traffic

**IMPORTANT NOTICE:** IEEE Standards documents are not intended to ensure safety, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers 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.

This IEEE document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Documents.” They can also be obtained on request from IEEE or viewed at <http://standards.ieee.org/IPR/disclaimers.html>.

(This amendment is based on IEEE Std 802.3™-2015 as amended by IEEE Std 802.3bw™-2015, IEEE Std 802.3by™-2016, IEEE Std 802.3bp™-2016, and IEEE Std 802.3bp™-2016.

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 ~~strike through~~ (to remove old material) and underline (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.<sup>1</sup>

Cross references that refer to clauses, tables, equations, or figures not covered by this amendment are highlighted in green.

<sup>1</sup>Notes in text, tables, and figures are given for information only, and do not contain requirements needed to implement the standard.

## 1. Introduction

### 1.4 Definitions

*Insert the following two new definitions into the list after 1.4.197 Exception Window:*

**1.4.197a express Media Access Control (eMAC):** The instance of a Media Access Control sublayer (IEEE Std 802.3, Annex 4A) that is the client of a MAC Merge sublayer service interface that handles express traffic. (See IEEE Std 802.3, Clause 99.)

**1.4.197b express traffic:** Frames transmitted through an express Media Access Control (eMAC) sublayer. (See IEEE Std 802.3, Clause 99.)

*Insert the following new definition into the list after 1.4.261 MAC frame:*

**1.4.261a MAC Merge sublayer:** An optional sublayer that supports interspersing express traffic with preemptable traffic by attaching an express Media Access Control (eMAC) and a preemptable Media Access Control (pMAC) to a single Physical Signaling Sublayer (PLS) service. (See IEEE Std 802.3, Clause 99.)

*Insert the following two new definitions into the list after 1.4.339 Powered Device (PD):*

**1.4.339a preemptable Media Access Control (pMAC):** The instance of a Media Access Control sublayer (IEEE Std 802.3, Annex 4A) that is the client of a MAC Merge sublayer service interface that handles preemptable traffic. (See IEEE Std 802.3, Clause 99.)

**1.4.339b preemptable traffic:** Frames transmitted through a preemptable Media Access Control (pMAC) sublayer (See IEEE Std 802.3, Clause 99.)

### 1.5 Abbreviations

*Insert the following new abbreviations into the list, in alphabetical order:*

|      |                                  |
|------|----------------------------------|
| eMAC | express Media Access Control     |
| MMSI | MAC Merge service interface      |
| pMAC | preemptable Media Access Control |

## 30. Management

### 30.2 Managed objects

#### 30.2.2 Overview of managed objects

##### 30.2.2.1 Text description of managed objects

*Change the description of oMACEntity as follows:*

|                   |   |
|-------------------|---|
| <b>oMACEntity</b> | If oMACControlEntity is implemented, oMACEntity is contained within oMACControlEntity. Otherwise, if oOAM is implemented, oMACEntity is contained within oOAM. Otherwise, if oAggregator is implemented, oMACEntity is contained within oAggregator. Otherwise, oMACEntity becomes the top-most managed object class of the DTE containment tree shown in Figure 30–3. Note that this managed object class may be contained within another superior managed object class. Such containment is expected, but is outside the scope of this International Standard. <u>If oMACMergeEntity is implemented, the oMACEntity for the express MAC (eMAC) and the oMACEntity for the preemptable MAC (pMAC) are connected to an instance of oMACMergeEntity.</u> |
|-------------------|---|

*Insert the following new description into the list in alphabetical order:*

|                        |  |
|------------------------|--|
| <b>oMACMergeEntity</b> | If implemented, a single instance of oMACMergeEntity is contained within oMACEntity for an express MAC (eMAC) and oMACEntity for a preemptable MAC (pMAC) (see Clause 99). oMACMergeEntity managed object class provides the management controls necessary for the MAC Merge sublayer. |
|------------------------|--|

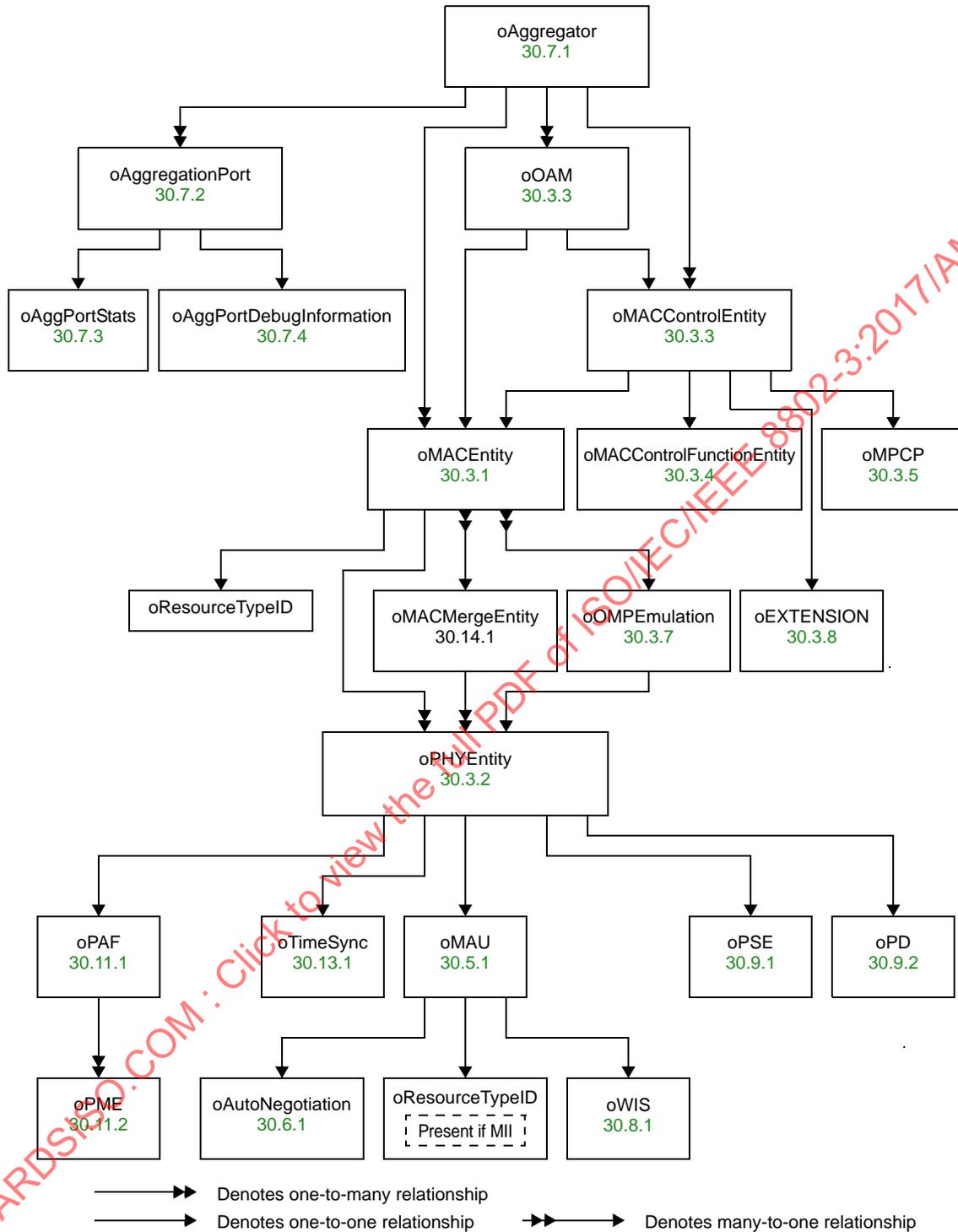
*Change the description of oPHYEntity as follows:*

|                   |   |
|-------------------|---|
| <b>oPHYEntity</b> | If oOMPemulation is implemented, oPHYEntity is contained within oOMPemulation. <u>If oMACMergeEntity is implemented, oPHYEntity is contained within oPHYEntity.</u> Otherwise oPHYEntity is contained within oMACEntity. Many instances of oPHYEntity may coexist within one instance of oMACEntity <u>or oMACMergeEntity</u> ; however, only one PHY may be active for data transfer to and from the MAC at any one time. oPHYEntity is the managed object that contains the MAU, PAF, and PSE managed objects in a DTE. |
|-------------------|---|

##### 30.2.3 Containment

*Replace Figure 30-3 with a new Figure 30–3 as follows:*

IEEE Std 802.3br-2016  
 IEEE Standard for Ethernet—Amendment 5:  
 Specification and Management Parameters for Interspersing Express Traffic



NOTE—The objects oAggregator, oAggregationPort, oAggPortStats, and oAggPortDebugInformation are deprecated by IEEE Std 802.1AX™-2008.

Figure 30-3—DTE System entity relationship diagram

**30.2.5 Capabilities**

*Change the first paragraph in 30.2.5 and insert Table 30–8 and Table 30–9 as follows:*

This standard makes use of the concept of *packages* as defined in ISO/IEC 10165-4:1992 as a means of grouping behaviour, attributes, actions, and notifications within a managed object class definition. Packages may either be mandatory, or be conditional, that is to say, present if a given condition is true. Within this standard *capabilities* are defined, each of which corresponds to a set of packages, which are components of a number of managed object class definitions and which share the same condition for presence. Implementation of the appropriate Basic and Mandatory packages is the minimum requirement for claiming conformance to IEEE 802.3 Management. Implementation of an entire optional capability is required in order to claim conformance to that capability. The capabilities and packages for IEEE 802.3 Management are specified in Table 30–1a through ~~Table 30–7~~Table 30–9.

**Table 30–8—LLDP capabilities (additional packages)**

|   |           |         |  |                                   |
|---|-----------|---------|--|-----------------------------------|
|   |           |         |  |                                   |
|   |           |         |  | LLDP MAC Merge Package (optional) |
| <b>oLldpXdot3LocSystemsGroup managed object class (30.14)</b> |           |         |  |                                   |
| aLldpXdot3LocPreemptSupported                                 | ATTRIBUTE | GET     |  | X                                 |
| aLldpXdot3LocPreemptEnabled                                   | ATTRIBUTE | GET     |  | X                                 |
| aLldpXdot3LocPreemptActive                                    | ATTRIBUTE | GET     |  | X                                 |
| aLldpXdot3LocAddFragSize                                      | ATTRIBUTE | GET-SET |  | X                                 |
| aLldpXdot3RemPreemptSupported                                 | ATTRIBUTE | GET     |  | X                                 |
| aLldpXdot3RemPreemptEnabled                                   | ATTRIBUTE | GET     |  | X                                 |
| aLldpXdot3RemPreemptActive                                    | ATTRIBUTE | GET     |  | X                                 |
| aLldpXdot3RemAddFragSize                                      | ATTRIBUTE | GET     |  | X                                 |

Table 30–9—MAC Merge sublayer capabilities

|   |           |         |  | MAC Merge Basic Package (mandatory) |
|---|-----------|---------|--|-------------------------------------|
| <b>oMACMergeEntity managed object class</b> |           |         |  |                                     |
| aMACMergeSupport                            | ATTRIBUTE | GET     |  | X                                   |
| aMACMergeStatusVerify                       | ATTRIBUTE | GET     |  | X                                   |
| aMACMergeEnableTx                           | ATTRIBUTE | GET-SET |  | X                                   |
| aMACMergeVerifyDisableTx                    | ATTRIBUTE | GET-SET |  | X                                   |
| aMACMergeStatusTx                           | ATTRIBUTE | GET     |  | X                                   |
| aMACMergeVerifyTime                         | ATTRIBUTE | GET-SET |  | X                                   |
| aMACMergeAddFragSize                        | ATTRIBUTE | GET     |  | X                                   |
| aMACMergeFrameAssErrorCount                 | ATTRIBUTE | GET     |  | X                                   |
| aMACMergeFrameSmdErrorCount                 | ATTRIBUTE | GET     |  | X                                   |
| aMACMergeFrameAssOkCount                    | ATTRIBUTE | GET     |  | X                                   |
| aMACMergeFragCountRx                        | ATTRIBUTE | GET     |  | X                                   |
| aMACMergeFragCountTx                        | ATTRIBUTE | GET     |  | X                                   |
| aMACMergeHoldCount                          | ATTRIBUTE | GET     |  | X                                   |

### 30.12 Layer Management for Link Layer Discovery Protocol (LLDP)

#### 30.12.1 LLDP Configuration managed object class

##### 30.12.1.1 LLDP Configuration attributes

###### 30.12.1.1.1 aLldpXdot3PortConfigTLVsTxEnable

Change 30.12.1.1.1 as follows:

ATTRIBUTE

APPROPRIATE SYNTAX:

BITSTRING

BEHAVIOUR DEFINED AS:

A read-write string of 67 bits indicating, for each of the IEEE 802.3 optional LLDP TLVs, if transmit is enabled on the local LLDP agent by the network management. A “1” in the bitstring indicates transmit of the TLV is enabled, “0” indicates transmit of the TLV is disabled. The value of this attribute is preserved across reset including loss of power.

The first bit indicates if MAC/PHY configuration/status TLV transmit is enabled, the second bit indicates if Power via MDI TLV transmit is enabled, the third bit indicates if the deprecated Link Aggregation TLV transmit is enabled, the fourth bit indicates if the Maximum Frame Size TLV transmit is enabled, the fifth bit indicates if the EEE TLV is enabled, and the sixth bit indicates if the EEE Fast Wake TLV is enabled.; Each bit of the bit string indicates whether transmit is enabled for the TLV corresponding to the bit. The mapping of bits to TLVs is:

|                |   |
|----------------|---|
| <u>first</u>   | <u>MAC/PHY configuration/status TLV</u>       |
| <u>second</u>  | <u>Power via MDI TLV</u>                      |
| <u>third</u>   | <u>Link Aggregation TLV (deprecated)</u>      |
| <u>fourth</u>  | <u>Maximum Frame Size TLV</u>                 |
| <u>fifth</u>   | <u>EEE TLV</u>                                |
| <u>sixth</u>   | <u>EEE Fast Wake TLV</u>                      |
| <u>seventh</u> | <u>Additional Ethernet Capabilities TLV.;</u> |

### 30.12.2 LLDP Local System Group managed object class

#### 30.12.2.1 LLDP Local System Group attributes

*Insert 30.12.2.1.34 through 30.12.2.1.37 after 30.12.2.1.33 as follows:*

##### 30.12.2.1.34 aLldpXdot3LocPreemptSupported

ATTRIBUTE

APPROPRIATE SYNTAX:  
BOOLEAN

BEHAVIOUR DEFINED AS:

A read-only Boolean value used to indicate whether the given port (associated with the local System) supports the preemption capability.;

##### 30.12.2.1.35 aLldpXdot3LocPreemptEnabled

ATTRIBUTE

APPROPRIATE SYNTAX:  
BOOLEAN

BEHAVIOUR DEFINED AS:

A read-only Boolean value used to indicate whether the preemption capability is enabled on the given port associated with the local System.;

##### 30.12.2.1.36 aLldpXdot3LocPreemptActive

ATTRIBUTE

APPROPRIATE SYNTAX:  
BOOLEAN

BEHAVIOUR DEFINED AS:

A read-only Boolean value used to indicate whether the preemption capability is active on the given port associated with the local System.;

### 30.12.2.1.37 aLldpXdot3LocAddFragSize

ATTRIBUTE

APPROPRIATE SYNTAX:  
 INTEGER

BEHAVIOUR DEFINED AS:

A 2-bit integer value used to indicate the minimum size of non-final fragments supported by the receiver on the given port associated with the local System. This value is expressed in units of 64 octets of additional fragment length. The minimum non-final fragment size is  $(\text{aLldpXdot3LocAddFragSize} + 1) \times 64$  octets.;

## 30.12.3 LLDP Remote System Group managed object class

### 30.12.3.1 LLDP Remote System Group attributes

*Insert 30.12.3.1.28 through 30.12.3.1.31 after 30.12.3.1.27 as follows:*

#### 30.12.3.1.28 aLldpXdot3RemPreemptSupported

ATTRIBUTE

APPROPRIATE SYNTAX:  
 BOOLEAN

BEHAVIOUR DEFINED AS:

A read-only Boolean value used to indicate whether the given port (associated with the remote system) supports the preemption capability.;

#### 30.12.3.1.29 aLldpXdot3RemPreemptEnabled

ATTRIBUTE

APPROPRIATE SYNTAX:  
 BOOLEAN

BEHAVIOUR DEFINED AS:

A read-only Boolean value used to indicate whether the preemption capability is enabled on the given port associated with the remote system.;

#### 30.12.3.1.30 aLldpXdot3RemPreemptActive

ATTRIBUTE

APPROPRIATE SYNTAX:  
 BOOLEAN

BEHAVIOUR DEFINED AS:

A read-only Boolean value used to indicate whether the preemption capability is active on the given port associated with the remote system.;

#### 30.12.3.1.31 aLldpXdot3RemAddFragSize

ATTRIBUTE

APPROPRIATE SYNTAX:  
 INTEGER

## BEHAVIOUR DEFINED AS:

A 2-bit integer value used to indicate, in units of 64 octets, the minimum number of octets over 64 octets required in non-final fragments by the receiver on the given port associated with the remote system. The minimum non-final fragment size is  $(aLdpXdot3LocAddFragSize + 1) \times 64$  octets.;

*Insert a new subclause 30.14 after 30.13 as follows:*

**30.14 Management for MAC Merge Sublayer****30.14.1 oMACMergeEntity managed object class**

This subclause formally defines the behaviours for the oMACMergeEntity managed object class attributes.

**30.14.1.1 aMACMergeSupport**

## ATTRIBUTE

## APPROPRIATE SYNTAX:

An ENUMERATED VALUE that has one of the following entries:

|               |   |
|---------------|---|
| supported     | MAC Merge sublayer is supported on the device     |
| not supported | MAC Merge sublayer is not supported on the device |

## BEHAVIOUR DEFINED AS:

This attribute indicates (when accessed via a GET operation) whether the given device supports a MAC Merge sublayer. The SET operation shall have no effect on a device.;

**30.14.1.2 aMACMergeStatusVerify**

## ATTRIBUTE

## APPROPRIATE SYNTAX:

An ENUMERATED VALUE that has one of the following entries:

|           |  |
|-----------|--|
| unknown   | verification status is unknown   |
| initial   | the Verify State diagram (Figure 99–8) is in the state INIT_VERIFICATION                     |
| verifying | the Verify State diagram is in the state VERIFICATION_IDLE, SEND_VERIFY or WAIT_FOR_RESPONSE |
| succeeded | indicates that the Verify State diagram is in the state VERIFIED                             |
| failed    | the Verify State diagram is in the state VERIFY_FAIL   |
| disabled  | verification of preemption operation is disabled   |

## BEHAVIOUR DEFINED AS:

This attribute indicates (when accessed via a GET operation) the status of the MAC Merge sublayer verification on the given device. The SET operation shall have no effect on a device.;

**30.14.1.3 aMACMergeEnableTx**

## ATTRIBUTE

## APPROPRIATE SYNTAX:

An ENUMERATED VALUE that has one of the following entries:

|          |                                 |
|----------|---------------------------------|
| disabled | transmit preemption is disabled |
| enabled  | transmit preemption is enabled  |

**BEHAVIOUR DEFINED AS:**

This attribute indicates (when accessed via a GET operation) the status of the MAC Merge sublayer on the given device in the transmit direction. The status of the MAC Merge sublayer may be modified to the indicated value via a SET operation. This attribute maps to the variable pEnable (see 99.4.7.3).;

**30.14.1.4 aMACMergeVerifyDisableTx**

## ATTRIBUTE

## APPROPRIATE SYNTAX:

An ENUMERATED VALUE that has one of the following entries:

|          |                    |
|----------|--------------------|
| disabled | verify is disabled |
| enabled  | verify is enabled  |

**BEHAVIOUR DEFINED AS:**

This attribute indicates (when accessed via a GET operation) the status of the Verify function of MAC Merge sublayer on the given device in the transmit direction. The status of the Verify function may be modified to the indicated value via a SET operation. This attribute maps to the variable disableVerify (see 99.4.7.3).;

**30.14.1.5 aMACMergeStatusTx**

## ATTRIBUTE

## APPROPRIATE SYNTAX:

An ENUMERATED VALUE that has one of the following entries:

|          |                                       |
|----------|---------------------------------------|
| unknown  | transmit preemption status is unknown |
| inactive | transmit preemption is inactive       |
| active   | transmit preemption is active         |

**BEHAVIOUR DEFINED AS:**

This attribute indicates (when accessed via a GET operation) the status of the MAC Merge sublayer on the given device in the transmit direction. The SET operation shall have no effect on a device. This attribute maps to the variable preempt (see 99.4.7.3).;

**30.14.1.6 aMACMergeVerifyTime**

## ATTRIBUTE

## APPROPRIATE SYNTAX:

INTEGER

**BEHAVIOUR DEFINED AS:**

The value of this attribute defines the nominal wait time between verification attempts in milliseconds. Valid range is 1 to 128 inclusive. The default value is 10. This attribute maps to the variable verifyTime (see 99.4.7.3).;

**30.14.1.7 aMACMergeAddFragSize**

## ATTRIBUTE

## APPROPRIATE SYNTAX:

INTEGER

**BEHAVIOUR DEFINED AS:**

A 2-bit integer value used to indicate the value of addFragSize variable used by the Transmit Processing State Diagram (see Figure 99-5).;

#### 30.14.1.8 aMACMergeFrameAssErrorCount

ATTRIBUTE

APPROPRIATE SYNTAX:

Generalized nonresettable counter.

This counter has a maximum increment rate of 160 000 counts per second at 100 Mb/s.

BEHAVIOUR DEFINED AS:

A count of MAC frames with reassembly errors. The counter is incremented by one every time the ASSEMBLY\_ERROR state in the Receive Processing State Diagram is entered (see Figure 99–6).;

#### 30.14.1.9 aMACMergeFrameSmdErrorCount

ATTRIBUTE

APPROPRIATE SYNTAX:

Generalized nonresettable counter.

This counter has a maximum increment rate of 160 000 counts per second at 100 Mb/s.

BEHAVIOUR DEFINED AS:

A count of received MAC frames / MAC frame fragments rejected due to unknown SMD value or arriving with an SMD-C when no frame is in progress. The counter is incremented by one every time the BAD\_FRAG state in the Receive Processing State Diagram is entered and every time the WAIT\_FOR\_DV\_FALSE state is entered due to the invocation of the SMD\_DECODE function returning the value “ERR” (see Figure 99–6).;

#### 30.14.1.10 aMACMergeFrameAssOkCount

ATTRIBUTE

APPROPRIATE SYNTAX:

Generalized nonresettable counter.

This counter has a maximum increment rate of 160 000 counts per second at 100 Mb/s.

BEHAVIOUR DEFINED AS:

A count of MAC frames that were successfully reassembled and delivered to MAC. The counter is incremented by one every time the FRAME\_COMPLETE state in the Receive Processing state diagram (see Figure 99–6) is entered if the state CHECK\_FOR\_RESUME was previously entered while processing the packet.;

#### 30.14.1.11 aMACMergeFragCountRx

ATTRIBUTE

APPROPRIATE SYNTAX:

Generalized nonresettable counter.

This counter has a maximum increment rate of 160 000 counts per second at 100 Mb/s.

BEHAVIOUR DEFINED AS:

A count of the number of additional mPackets received due to preemption. The counter is incremented by one every time the state CHECK\_FRAG\_CNT in the Receive Processing State Diagram (see Figure 99–6) is entered.;

#### 30.14.1.12 aMACMergeFragCountTx

ATTRIBUTE

APPROPRIATE SYNTAX:

Generalized nonresettable counter.

This counter has a maximum increment rate of 160 000 counts per second at 100 Mb/s

BEHAVIOUR DEFINED AS:

A count of the number of additional mPackets transmitted due to preemption. This counter is incremented by one every time the SEND\_SMD\_C state in the Transmit Processing State Diagram (see Figure 99–5) is entered.;

#### 30.14.1.13 aMACMergeHoldCount

ATTRIBUTE

APPROPRIATE SYNTAX:

Generalized nonresettable counter.

This counter has a maximum increment rate of 160 000 counts per second at 100 Mb/s.

BEHAVIOUR DEFINED AS:

A count of the number of times the variable hold (see 99.4.7.3) transitions from FALSE to TRUE.;

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC/IEEE 8802-3:2017/Amd5:2017

## 79. IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and value (TLV) information elements

### 79.3 IEEE 802.3 Organizationally Specific TLVs

Insert the following row in Table 79–1 and change the range in the subtype column of the last row to remove the assigned subtype value.

Table 79–1—IEEE 802.3 Organizationally Specific TLVs

| IEEE 802.3 subtype | TLV name                         | Subclause reference |
|--------------------|----------------------------------|---------------------|
| 7                  | Additional Ethernet Capabilities | 79.3.7              |
| 7 8 to 255         | Reserved                         | —                   |

Insert a new subclause 79.3.7 after 79.3.6.4 as follows:

#### 79.3.7 Additional Ethernet Capabilities TLV

The Additional Ethernet Capabilities TLV is an optional TLV that indicates which additional capabilities are supported. Figure 79–8 shows the format of this TLV.

NOTE—MAC and PHY support for a given frame size does not necessarily mean that the upper layers support that frame size.

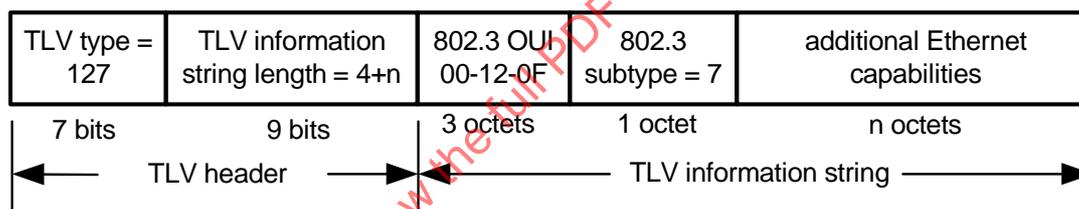


Figure 79–8—Additional Ethernet Capabilities TLV

##### 79.3.7.1 Additional Ethernet capabilities

The additional Ethernet capabilities field shall contain a bitmap that identifies the support and current status of additional Ethernet capabilities on the local IEEE 802.3 LAN station. The first two octets of the field are defined in Table 79–7a. Additional octets are reserved.

An implementation shall transmit all Reserved bits as zero and ignore received Reserved bits. Reserved octets shall not be transmitted and if more octets are received than were defined as other than Reserved, the additional octet(s) shall be ignored. If fewer octet(s) are received than defined, the implementation shall act as if the additional octet(s) were received as zero.

##### 79.3.7.2 Additional Ethernet Capabilities TLV usage rules

An LLDPDU should contain no more than one Additional Ethernet Capabilities TLV. Since this TLV is intended to inform a link partner of capabilities, the Additional Ethernet Capabilities TLV should be sent in an LLDPDU addressed to the Nearest Bridge group address (see IEEE Std 802.1Q).

IEEE Std 802.3br-2016  
 IEEE Standard for Ethernet—Amendment 5:  
 Specification and Management Parameters for Interspersing Express Traffic

**Table 79–7a—Additional Ethernet capabilities**

| Bit  | Function                      | Value/meaning  | Reference |
|------|-------------------------------|--|-----------|
| 0    | preemption capability support | 1 = supported<br>0 = not supported   | 99.4.2    |
| 1    | preemption capability status  | 1 = enabled<br>0 = not enabled   | 99.4.2    |
| 2    | preemption capability active  | 1 = active<br>0 = not active   | 99.4.3    |
| 4:3  | additional fragment size      | A 2-bit integer value indicating, in units of 64 octets, the minimum number of octets over 64 octets required in non-final fragments by the receiver | 99.4.4    |
| 15:5 | Reserved                      | —  | —         |

**79.4 IEEE 802.3 Organizationally Specific TLV selection management**

**79.4.2 IEEE 802.3 Organizationally Specific TLV/LLDP Local and Remote System group managed object class cross references**

*Insert new rows at the bottom of Table 79–9 and Table 79–10.*

**Table 79–9—IEEE 802.3 Organizationally Specific TLV/LLDP Local System Group managed object class cross references**

| TLV name                         | TLV variable                  | LLDP Local System Group managed object class attribute |
|----------------------------------|-------------------------------|--|
| Additional Ethernet Capabilities | preemption capability support | aLldpXdot3LocPreemptSupported                          |
|                                  | preemption capability status  | aLldpXdot3LocPreemptEnabled                            |
|                                  | preemption capability active  | aLldpXdot3LocPreemptActive                             |
|                                  | additional fragment size      | aLldpXdot3LocAddFragSize                               |

**Table 79–10—IEEE 802.3 Organizationally Specific TLV/LLDP Remote System Group managed object class cross references**

| TLV name                         | TLV variable                  | LLDP Remote System Group managed object class attribute |
|----------------------------------|-------------------------------|---|
| Additional Ethernet Capabilities | preemption capability support | aLldpXdot3RemPreemptSupported                           |
|                                  | preemption capability status  | aLldpXdot3RemPreemptEnabled                             |
|                                  | preemption capability active  | aLldpXdot3RemPreemptActive                              |
|                                  | additional fragment size      | aLldpXdot3RemAddFragSize                                |

STANDARDSISO.COM : Click to view the full PDF of ISO/IEC/IEEE 8802-3:2017/Amd5:2017

**79.5 Protocol implementation conformance statement (PICS) proforma for IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and value (TLV) information elements<sup>2</sup>**

**79.5.3 Major capabilities/options**

*Insert one row at the bottom of the table in 79.5.3:*

| Item | Feature                              | Subclause | Value/Comment | Status | Support           |
|------|--------------------------------------|-----------|---------------|--------|-------------------|
| *AE  | Additional Ethernet Capabilities TLV | 79.3.7    |               | O      | Yes [ ]<br>No [ ] |

*Insert a new subclause 79.5.11 after 79.5.10 as follows:*

**79.5.11 Additional Ethernet Capabilities TLV**

| Item | Feature                     | Subclause | Value/Comment  | Status | Support                      |
|------|-----------------------------|-----------|--|--------|------------------------------|
| AET1 | Ethernet capabilities field | 79.3.7.1  | Contains a bitmap that identifies the support and current status of additional Ethernet capabilities       | AE:M   | Yes [ ]<br>N/A [ ]           |
| AET2 | Reserved bits               | 79.3.7.1  | Set to zero and ignored on receipt   | AE:M   | Yes [ ]<br>N/A [ ]           |
| AET3 | Reserved octets             | 79.3.7.1  | Not transmitted and ignored on receipt   | AE:M   | Yes [ ]<br>N/A [ ]           |
| AET4 | octets not received         | 79.3.7.1  | Treated as all zero  | AE:M   | Yes [ ]<br>N/A [ ]           |
| AET5 | usage rule—at most one      | 79.3.7.2  | LLDPDU should contain no more than one Additional Ethernet Capabilities TLV                                | AE:O   | Yes [ ]<br>No [ ]<br>N/A [ ] |
| AET6 | usage rule—address          | 79.3.7.2  | Additional Ethernet Capabilities TLV should be sent in an LLDPDU addressed to Nearest Bridge group address | AE:O   | Yes [ ]<br>No [ ]<br>N/A [ ] |

<sup>2</sup>Copyright release for PICS proformas: Users of this standard may freely reproduce the PICS proforma in this subclause so that it can be used for its intended purpose and may further publish the completed PICS.

## 90. Ethernet support for time synchronization protocols

### 90.4 Time Synchronization Service Interface (TSSI)

#### 90.4.3 Detailed service specification

##### 90.4.3.1 TS\_TX.indication primitive

*Change 90.4.3.1.1 as follows:*

###### 90.4.3.1.1 Semantics

The semantics of the primitive are as follows:

TS\_TX.indication(SFD, MM)

The SFD parameter can take only one possible value, DETECTED. When asserted (SFD = DETECTED), the TimeSync Client is notified that a valid SFD was detected by the gRS sublayer TS\_SFD\_Detect\_TX function (see 90.5.1) in the xMII transmit signals.

The MM parameter is mandatory when the MAC Merge sublayer (see Clause 99) is instantiated. The MM parameter, when present, can take one of two possible values, i.e., PMAC or EMAC. The value EMAC indicates the SMD-E (SFD) value has been detected at the xMII. The value PMAC indicates that an SMD-S value has been detected at the xMII (see Table 99–1). The MM parameter is not provided when MAC Merge sublayer is not instantiated.

##### 90.4.3.2 TS\_RX.indication primitive

*Change 90.4.3.2.1 as follows:*

###### 90.4.3.2.1 Semantics

The semantics of the primitive are as follows:

TS\_RX.indication(SFD, MM)

The SFD parameter can take only one possible value, DETECTED. When asserted (SFD = DETECTED), the TimeSync Client is notified that a valid SFD was detected by the gRS sublayer TS\_SFD\_Detect\_RX function (see 90.5.2) in the xMII receive signals.

The MM parameter is mandatory when the MAC Merge sublayer (see Clause 99) is instantiated. The MM parameter, when present, can take one of two possible values, i.e., PMAC or EMAC. The value EMAC indicates the SMD-E (SFD) value has been detected at the xMII. The value PMAC indicates that an SMD-S value has been detected at the xMII (see Table 99–1). The MM parameter is not provided when MAC Merge sublayer is not instantiated.

### 90.5 generic Reconciliation Sublayer (gRS)

*Change the first paragraph of 90.5 as follows:*

Within the scope of this clause, the term generic Reconciliation Sublayer (gRS) is used to denote any IEEE 802.3 Reconciliation Sublayer (RS) used to interface a MAC with any PHY supporting the TimeSync

capability through the xMII. The behavior of the gRS depends on whether a MAC Merge sublayer (see Clause 99) is instantiated above the gRS.

*Change 90.5.1 and 90.5.2 as follows:*

#### **90.5.1 TS\_SFD\_Detect\_TX function**

The TS\_SFD\_Detect\_TX function observes the xMII transmit signals.

When the MAC Merge sublayer is not instantiated, the TS SFD Detect TX function ~~and~~ detects the occurrence of the Start Frame Delimiter (SFD, see 3.1.1 and 3.2.2) in compliance with the specifications of the given type of the instantiated xMII. The service primitive across the TSSI, i.e., TS\_TX.indication, shall be generated only when the SFD is detected on the transmit signals of the xMII (SFD=DETECTED).

When the MAC Merge sublayer is instantiated, the TS SFD Detect TX function detects the occurrence of the Start mPacket Delimiter for an express packet or preemptable packet start (SMD-E or SMD-S, see 99.3.3) in compliance with the specifications of the given type of the instantiated xMII. The service primitive across the TSSI, i.e., TS\_TX.indication, shall be generated only when the SMD-E or SMD-S is detected on the transmit signals of the xMII (SFD=DETECTED). The value of MM shall indicate whether an SMD-E (MM=EMAC) or an SMD-S (MM=PMAC) was detected.

#### **90.5.2 TS\_SFD\_Detect\_RX function**

The TS\_SFD\_Detect\_RX function observes the xMII receive signals.

When the MAC Merge sublayer is not instantiated, the TS SFD Detect RX function ~~and~~ detects the occurrence of the Start Frame (SFD, see 3.1.1 and 3.2.2) in compliance with the specifications of the given type of the instantiated xMII. The service primitive across the TSSI, i.e., TS\_RX.indication, shall be generated only when the SFD is detected on the receive signals of the xMII (SFD=DETECTED).

When the MAC Merge sublayer is instantiated, the TS SFD Detect RX function detects the occurrence of the Start mPacket Delimiter for an express packet or preemptable packet start (SMD-E or SMD-S, see 99.3.3) in compliance with the specifications of the given type of the instantiated xMII. The service primitive across the TSSI, i.e., TS\_RX.indication, shall be generated only when the SMD-E or SMD-S is detected on the transmit signals of the xMII (SFD=DETECTED). The value of MM shall indicate whether an SMD-E (MM=EMAC) or an SMD-S (MM=PMAC) was detected.

**90.8 Protocol implementation conformance statement (PICS) proforma for Clause 90, Ethernet support for time synchronization protocols<sup>3</sup>**

*Change 90.8.3 as follows:*

**90.8.3 TSSI indication**

| Item  | Feature   | Subclause     | Value/Comment   | Status      | Support                          |
|-------|---|---------------|---|-------------|----------------------------------|
| *MM   | <u>MAC Merge</u>                                  | <u>90.5</u>   | <u>A MAC Merge sublayer is instantiated above gRS</u>   | <u>0</u>    | <u>Yes [ ]</u><br><u>No [ ]</u>  |
| TS_TX | TS_TX.indication generation                       | 90.5.1        | TS_TX.indication is generated only when the SFD is detected on the transmit signals of the xMII.              | <u>MM:M</u> | <u>Yes [ ]</u><br><u>N/A [ ]</u> |
| TS_RX | TS_RX.indication generation                       | 90.5.2        | TS_RX.indication is generated only when the SFD is detected on the receive signals of the xMII.               | <u>MM:M</u> | <u>Yes [ ]</u><br><u>N/A [ ]</u> |
| TS_T2 | <u>TS_TX.indication generation with MAC Merge</u> | <u>90.5.1</u> | <u>TS_TX.indication is generated only when SMD-E or SMD-S is detected on the transmit signals of the xMII</u> | <u>MM:M</u> | <u>Yes [ ]</u><br><u>N/A [ ]</u> |
| TS_T3 | <u>MM parameter for TS_TX</u>                     | <u>90.5.1</u> | <u>Value of MM parameter indicates whether an SMD-E or SMD-S is detected.</u>                                 | <u>MM:M</u> | <u>Yes [ ]</u><br><u>N/A [ ]</u> |
| TS_R2 | <u>TS_RX.indication generation with MAC Merge</u> | <u>90.5.2</u> | <u>TS_RX.indication is generated only when SMD-E or SMD-S is detected on the receive signals of the xMII</u>  | <u>MM:M</u> | <u>Yes [ ]</u><br><u>N/A [ ]</u> |
| TS_R3 | <u>MM parameter for TS_RX</u>                     | <u>90.5.2</u> | <u>Value of MM parameter indicates whether an SMD-E or SMD-S is detected.</u>                                 | <u>MM:M</u> | <u>Yes [ ]</u><br><u>N/A [ ]</u> |

<sup>3</sup>Copyright release for PICS proformas: Users of this standard may freely reproduce the PICS proforma in this subclause so that it can be used for its intended purpose and may further publish the completed PICS.

*Insert a new Clause 99 as follows:*

## 99. MAC Merge sublayer

### 99.1 Introduction

This clause specifies an optional MAC Merge sublayer for use with a pair of full-duplex MACs and a single PHY operating at 100 Mb/s or higher on a point-to-point link. The two MACs are:

- a preemptable MAC (pMAC), which carries the preemptable traffic, and
- an express MAC (eMAC), which carries the express traffic.

The MAC Merge sublayer supports interspersing express traffic with preemptable traffic. This is achieved by using a MAC Merge sublayer to attach an express Media Access Control (MAC) and a preemptable MAC to a single Reconciliation Sublayer (RS) service. The MAC Merge sublayer supports two ways to hold transmission of preemptable traffic in the presence of express traffic:

- the MAC Merge sublayer may preempt (interrupt) preemptable traffic being currently transmitted, and
- the MAC Merge sublayer may prevent starting the transmission of preemptable traffic.

This clause also specifies a MAC Merge Service Interface (MMSI) providing a primitive that causes the transmission of preemptable traffic to be held or released, minimizing the latency for express traffic. For example, when the MAC Client supports scheduled traffic as defined in IEEE Std 802.1Q, transmission of preemptable packets can be held before express traffic is scheduled to be transmitted.<sup>4</sup>

When the preemption capability is active, the MAC Merge sublayer allows frames provided over the express MAC service interface (express traffic) or the MMSI service primitive to interrupt transmission of a frame provided over the preemptable MAC service interface.

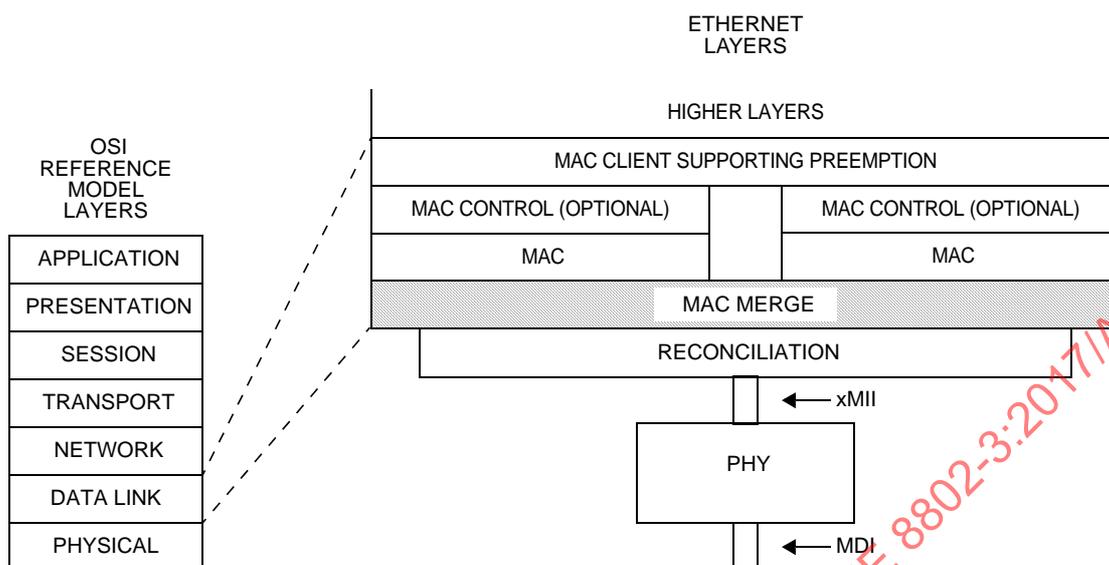
When the preemption capability is inactive, the MAC Merge sublayer does not allow express traffic or the MMSI service primitive to interrupt transmission of a frame provided over the preemptable MAC service interface.

Regardless of whether the preemption capability is active, the MAC Merge sublayer allows express traffic or the MMSI service primitive to prevent the start of transmission of frames provided over the preemptable MAC service interface (preemptable traffic).

The preemption capability is most useful at lower operating speeds. For example, the duration of a 2000 octet packet on a 100 Mb/s link is 160  $\mu$ s and on a 1 Gb/s link is 16  $\mu$ s. The time to transmit a maximum length packet is an upper bound on the additional delay before a MAC Client can send an Express frame when the preemption capability is not used. At higher operating speeds this additional delay gets smaller in proportion to the speed, reducing the advantage of the preemption mechanism.

Figure 99–1 shows the relationship of MAC Merge sublayer to the other sublayers and the ISO/IEC Open Systems Interconnection (OSI) reference model. The MAC Merge sublayer has two clients that are MAC sublayer instances: the eMAC and the pMAC.

<sup>4</sup>At the time of publication of this amendment, the content of IEEE Std 802.1Q relevant to this clause was separately published as IEEE Std 802.1Qbu™-2016, IEEE Standard for Local and metropolitan area networks—Bridges and Bridged Networks—Amendment 26: Frame Preemption, and IEEE Std 802.1Qbv™-2015, IEEE Standard for Local and metropolitan area networks—Bridges and Bridged Networks—Amendment 25: Enhancements for Scheduled Traffic.



NOTE—In this figure, the xMII is used as a generic term for the Media Independent Interfaces for implementations of 100 Mb/s and above. For example: for 100 Mb/s implementations this interface is called MII; for 1 Gb/s implementations it is called GMII; for 10 Gb/s implementations it is called XGMII; etc.

MAC = MEDIA ACCESS CONTROL  
 xMII = MEDIA INDEPENDENT INTERFACE

MDI = MEDIUM DEPENDENT INTERFACE  
 PHY = PHYSICAL LAYER DEVICE

**Figure 99–1—Relationship of MAC Merge sublayer to the ISO/IEC Open Systems Interconnection (OSI) reference model and the IEEE 802.3 Ethernet model**

Figure 99–2 shows the service interfaces of the MAC Merge sublayer and its associated MACs and Reconciliation Sublayer.

When attached to an eMAC or a pMAC, the MAC Control Sublayer shall not generate PAUSE (see Annex 31B).

Devices that implement the MAC Merge sublayer interoperate with devices that do not implement the MAC Merge sublayer. The preemption capability is enabled only after it has been determined that the link partner supports it (see 99.4.2).

### 99.1.1 Relationship to other IEEE standards

MAC Merge sublayer and its MACs provide support for Frame Preemption as defined in IEEE Std 802.1Q.

IEEE Std 802.3br-2016  
 IEEE Standard for Ethernet—Amendment 5:  
 Specification and Management Parameters for Interspersing Express Traffic

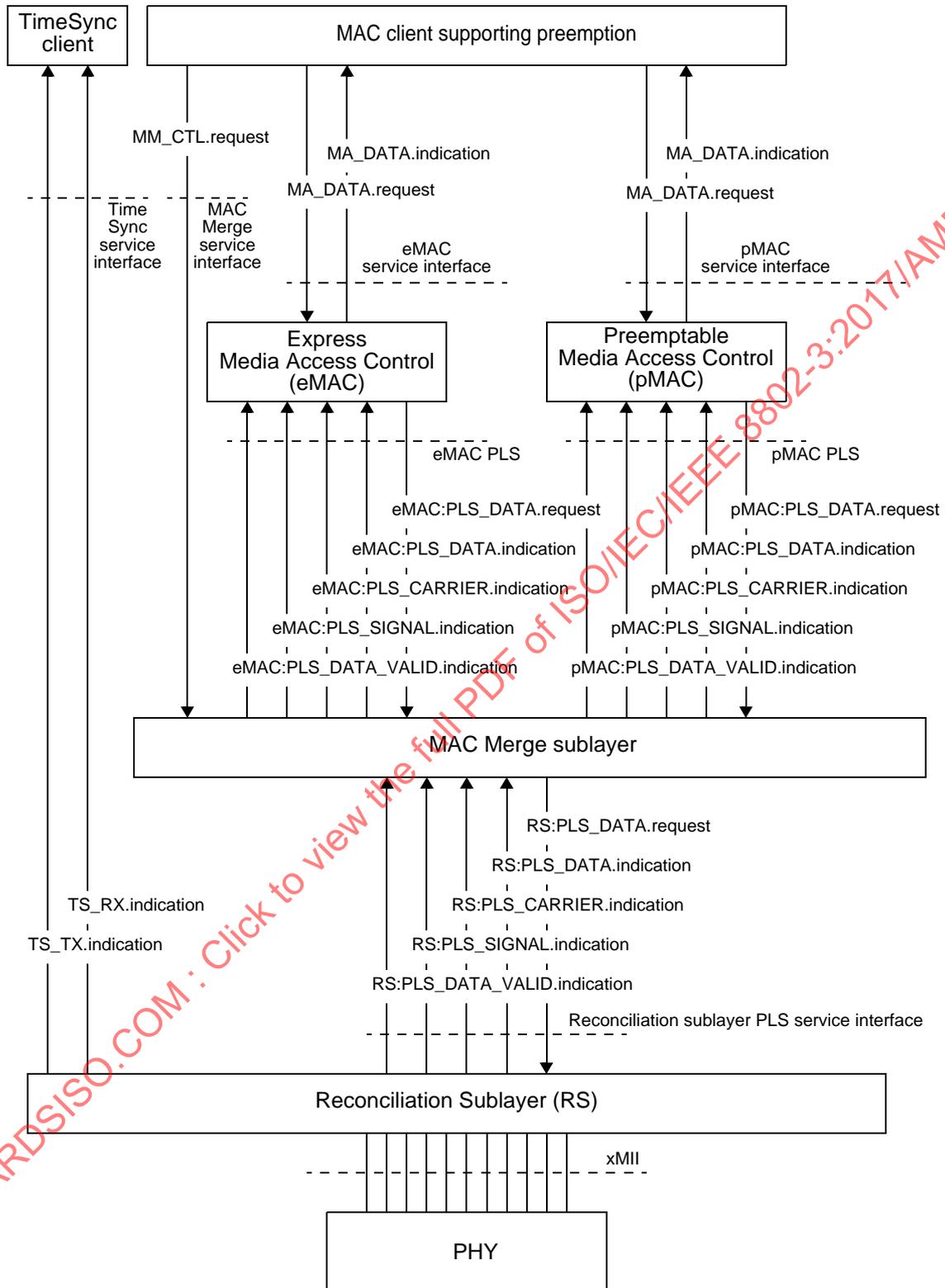


Figure 99-2—MAC Merge sublayer service interfaces diagram

### 99.1.2 Functional Block Diagram

Figure 99–3 provides a functional block diagram of the MAC Merge sublayer.

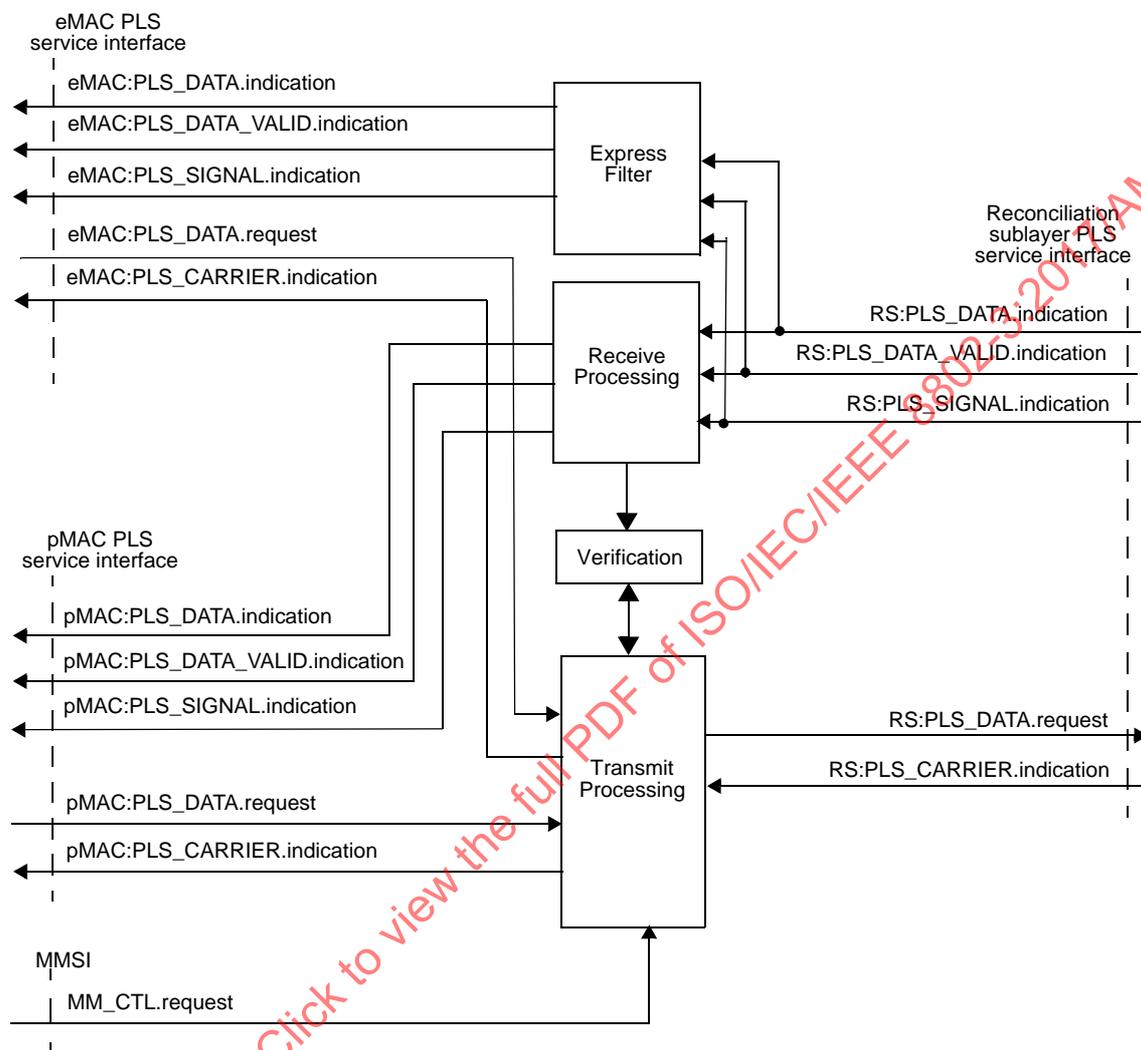


Figure 99–3—MAC Merge sublayer Functional Block Diagram

### 99.2 MAC Merge Service Interface (MMSI)

This subclause specifies the services provided by the MAC Merge sublayer to a MAC Client. The service interface is described in an abstract manner and does not imply any particular implementation. The model used in this service specification is identical to that used in 1.2.2.

The following primitive is defined:

- MM\_CTL.request

#### 99.2.1 MM\_CTL.request

This primitive defines a request from a MAC Client to MAC Merge sublayer to hold or release transmission of preemptable traffic.

### 99.2.1.1 Semantics

The semantics of the primitive are as follows:

MM\_CTL.request (hold\_req)

The hold\_req parameter takes one of two values, HOLD or RELEASE. The value of HOLD causes the MAC Merge sublayer to hold transmission of preemptable traffic. The value of RELEASE causes the MAC Merge sublayer to release transmission of preemptable traffic.

### 99.2.1.2 When generated

The generation of this primitive is out of scope of this standard.

### 99.2.1.3 Effect of receipt

Receipt of the primitive with the hold\_req parameter set to the value HOLD causes preemption when the conditions allow preemption and prevents starting transmission of pMAC packets until this primitive is received with the value RELEASE.

Receipt of the primitive with the hold\_req parameter set to the value RELEASE allows MAC Merge sublayer to transmit packets from the pMAC when the eMAC does not have a packet to transmit.

## 99.3 MAC Merge Packet (mPacket)

When the preemption capability is active, MAC Merge sublayer sends mPackets to the Reconciliation sublayer (RS). An mPacket contains one of the following:

- a complete express packet,
- a complete preemptable packet
- an initial fragment of a preemptable packet, or
- a continuation fragment of a preemptable packet.

### 99.3.1 mPacket format

Part (a) of Figure 99–4 shows the format of an mPacket containing an express packet, a complete preemptable packet, or the initial fragment of a preemptable packet. Part (b) of Figure 99–4 shows the format of an mPacket containing a continuation fragment of a packet.

The mPacket format is indicated by the value of the SMD (see 99.3.3).

### 99.3.2 Preamble

The preamble in the mPacket shown in part (a) of Figure 99–4 contains seven octets. The preamble in the mPacket shown in part (b) of Figure 99–4 contains six octets. Each octet contains the value of 0x55 (transmitted in order from left to right 10101010).

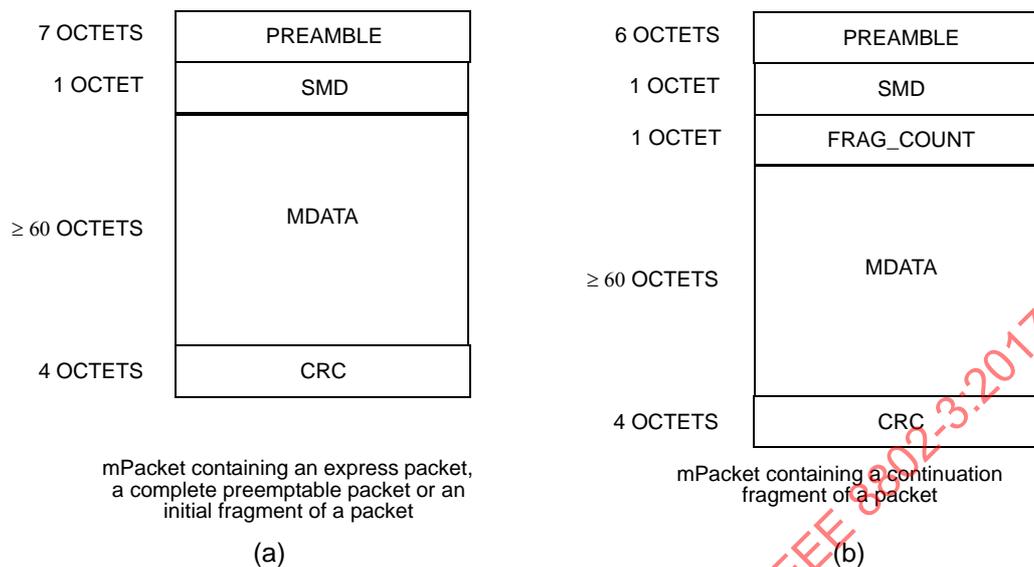


Figure 99-4—mPacket format

### 99.3.3 Start mPacket Delimiter (SMD)

The value of the SMD indicates whether the mPacket contains an express packet, the start of a preemptable packet (initial fragment or complete packet), or any of continuation fragments of a preemptable packet. All valid SMD values are defined in Table 99-1.

An mPacket carrying an express packet (transmitted by eMAC) has the same format as the express packet, because SMD-E (i.e., SMD value for an express packet) is same as the SFD value. An mPacket carrying a complete (non-fragmented) preemptable packet or the initial fragment of a preempted preemptable packet (transmitted by pMAC) has the SFD octet replaced with the appropriate SMD value. An mPacket carrying any of the continuation fragments of a preempted preemptable packet (transmitted by pMAC) has a continuation fragment SMD value, and includes an additional fragment counter octet (frag\_count) following the SMD.

The SMD in an mPacket carrying a complete (non-fragmented) preemptable packet or any of the fragments of a preemptable packet also indicates the frame count. Information about the frame count prevents reassembling an invalid packet if the final mPacket of one preemptable packet and the initial fragment of the next preemptable packet are lost. The frame count is a modulo-4 count.

The term “SMD-S” refers to any of the four SMD values (SMD-S0, SMD-S1, SMD-S2, and SMD-S3) in an mPacket carrying the start of a preemptable packet. The term “SMD-C” refers to any of the four SMD values (SMD-C0, SMD-C1, SMD-C2, and SMD-C3) in an mPacket carrying a continuation fragment of a preemptable packet.

Two additional SMD values, SMD-V and SMD-R, identify mPackets used to verify that a link can support the preemption capability.

### 99.3.4 frag\_count

The frag\_count is a modulo-4 counter that increments for each continuation fragment of the preemptable packet. The frag\_count protects against mPacket reassembly errors by enabling detection of the loss of up to 3 packet fragments.

IEEE Std 802.3br-2016  
 IEEE Standard for Ethernet—Amendment 5:  
 Specification and Management Parameters for Interspersing Express Traffic

**Table 99–1—SMD values**

| mPacket type             | Notation | Frame count | Value |
|--------------------------|----------|-------------|-------|
| verify packet            | SMD-V    | —           | 0x07  |
| respond packet           | SMD-R    | —           | 0x19  |
| express packet           | SMD-E    | —           | 0xD5  |
| preemptable packet start | SMD-S0   | 0           | 0xE6  |
|                          | SMD-S1   | 1           | 0x4C  |
|                          | SMD-S2   | 2           | 0x7F  |
|                          | SMD-S3   | 3           | 0xB3  |
| continuation fragment    | SMD-C0   | 0           | 0x61  |
|                          | SMD-C1   | 1           | 0x52  |
|                          | SMD-C2   | 2           | 0x9E  |
|                          | SMD-C3   | 3           | 0x2A  |

The frag\_count field is present only in mPackets with SMD-C. The frag\_count is zero in the first continuation fragment of each preemptable packet.

The valid frag\_count values are shown in Table 99–2.

**Table 99–2—Frag\_count values**

| Frag_count | Value |
|------------|-------|
| 0          | 0xE6  |
| 1          | 0x4C  |
| 2          | 0x7F  |
| 3          | 0xB3  |

### 99.3.5 mData

The contents of the frame from the MAC from the first octet after the SFD to the last octet before the FCS are sent in the mData fields of the one or more mPackets for that frame. The minimum size of the mData field is 60 octets.

NOTE—The Transmit Processing State Diagram ensures that the minimum mData field size is met. There is no pad field.

### 99.3.6 CRC

The CRC field contains a cyclic redundancy check (CRC) and an indication of whether this is the final mPacket of a frame.

In the final mPacket of a frame, the CRC field contains the last 4 octets of the MAC frame (the FCS field).

For other mPackets, the CRC field contains an mCRC value. This includes mPackets used to verify that a link can support the preemption capability. The mCRC shall be calculated on the octets of the frame from the first octet of the frame (i.e., the octet following the SFD sent by the pMAC) to the last octet of the frame transmitted in that mPacket by:

- performing steps a) through d) in 3.2.9, and then
- XORing the calculated 32 bits with 0x0000FFFF.

NOTE—0x0000 is XORed with two octets that contain the higher order coefficients of the CRC, and 0xFFFF is XORed with the two octets that contain the lower order coefficients of the CRC.

## 99.4 MAC Merge sublayer operation

The MAC Merge sublayer receiver always operates the same way regardless of whether preemption is active. This allows MAC Merge sublayers to enable and use preemption once the link partner has indicated support for it, without synchronizing the transition between the two ends of the link.

The express mPacket format is the same as the MAC packet format. As a result, any packet received from a device that does not implement the MAC Merge sublayer or that has preemption disabled is received through the eMAC.

### 99.4.1 MAC Merge sublayer transmit behavior when preemption is disabled

When preemption is disabled, the packets presented by the pMAC and eMAC pass through the MAC Merge sublayer without alteration, i.e., the MAC Merge sublayer transmits packets rather than mPackets. If both the eMAC and pMAC have packets ready to transmit and no packet is being transmitted, the eMAC packet is transmitted. If a pMAC packet is being transmitted and the eMAC has a packet to transmit, the packet from the eMAC is transmitted after transmission of the pMAC packet completes.

### 99.4.2 Determining that the link partner supports preemption

The preemption capability is enabled in the transmit direction only if it is determined that the link partner supports the preemption capability.

The process of discovering the support for the preemption capability on the link partner relies on the exchange of the Additional Ethernet Capabilities TLV (see 79.3.7).

The preemption capability shall be enabled only if the link partner announces its support for the preemption capability via an Additional Ethernet Capabilities TLV in an LLDPDU addressed to the Nearest Bridge group address (see IEEE Std 802.1Q). The preemption capability shall be disabled if the MAC Merge sublayer receives indication of link failure.

NOTE—Indication of link failure to the MAC Merge sublayer is implementation dependent.

### 99.4.3 Verifying preemption operation

Verification (see Figure 99–3) checks that the link can support the preemption capability.

If verification is enabled, the preemption capability shall be active only after verification has completed successfully.

If the preemption capability is enabled but has not been verified yet, the MAC Merge sublayer initiates verification. Verification relies on the transmission of a verify mPacket and receipt of a respond mPacket to

confirm that the remote station supports the preemption capability. The format of a verify mPacket and a respond mPacket is as shown in part (a) of Figure 99–4, with the SMD values defined in Table 99–1 and an mData field containing 60 octets of 0x00.

When an mPacket with an SMD-V and a correct mCRC is received, a respond mPacket is sent. A respond mPacket has 7 octets of preamble (0x55), an SMD-R, 60 octets of 0x00, and an mCRC.

When an mPacket with an SMD-R and a correct mCRC is received, the preemption capability is verified.

Verification may be disabled. Verification disable is intended for engineered closed networks (i.e., where it is ensured by design that links can support preemption capability). Verification disable does not affect the transmission of respond mPackets.

If verification is enabled, it shall be performed as specified in part (a) of Figure 99–8.

Respond shall be performed as in part (b) of Figure 99–8.

#### 99.4.4 Transmit processing

Transmit processing (see Figure 99–3) receives packets from the eMAC and pMAC. Transmit processing preempts a preemptable packet when a MM\_CTL.request primitive is received with a hold\_req parameter value of HOLD or the eMAC has a packet to transmit if that can be done while meeting minimum mPacket mData field size. Therefore, preemption occurs only if at least 60 octets of the preemptable frame have been transmitted and at least 64 octets (including the frame CRC) remain to be transmitted.

The earliest starting position of preemption is controlled by the addFragSize variable. Preemption does not occur until at least  $64 \times (1 + \text{addFragSize}) - 4$  octets of the preemptable frame have been sent. The addFragSize variable is set to the value of the addFragSize field in the received Additional Ethernet Capabilities TLV (see 79.3.7).

Transmit processing includes a CRC generator to calculate an mCRC as specified in 99.3.6.

When the preemption capability is active, transmit processing replaces the SFD of a pMAC packet with an SMD-S value. A 2-bit rolling frame count is encoded in the SMD-S value. The SMD-E value is the same as the SFD value so the SFD of an eMAC packet does not need to be replaced.

When a packet is preempted, transmit processing appends the mCRC to the non-final mPackets. For the final mPacket of a preempted frame, the CRC field contains the CRC of the preempted MAC frame (the FCS field).

Transmit processing resumes transmission of the remainder of a preempted packet by sending preamble followed by an SMD-C and frag\_count before continuing transmission of the packet. The SMD-C encodes the same frame count value as the SMD-S of the initial fragment.

Transmit processing shall be performed as specified in Figure 99–5.

If a PLS\_CARRIER.indication is received from the PLS, PLS\_CARRIER.indications with the same CARRIER\_STATUS shall be sent to the pMAC and the eMAC.

#### 99.4.5 Receive processing

Receive processing (see Figure 99–3) checks the SMD of each received mPacket. If an mPacket contains an SMD-E, Receive processing ignores the mPacket.

An SMD containing an SMD-S indicates the initial mPacket of a preemptable packet.

If an mPacket containing an SMD-S is received when Receive processing has not completed receiving the previous preempted packet, Receive processing shall ensure that the MAC detects a FrameCheckError in the partially received frame. This requirement may be met by producing a received frame data sequence delivered to the MAC sublayer that is guaranteed to not yield a valid CRC result, as specified by the frame check sequence algorithm (see 3.2.8). This data sequence may be produced by substituting data delivered to the MAC. It can do this by checking that the prior four octets sent to the MAC did not match the CRC of the data sent before them or by sending eight additional PLS\_DATA.indication primitives to the pMAC or by implementation dependent means. Other techniques may be employed to respond to an incomplete packet provided that the result is that the MAC sublayer behaves as though a FrameCheckError occurred in the received frame.

When an SMD-S is detected, receive processing records the frame count indicated by the SMD. Receive processing sends an SFD to the pMAC in place of the SMD and then begins sending PLS\_DATA.indication primitives to the pMAC.

Receive processing checks whether the last four octets of the mPacket match the mCRC. If the last four octets of the mPacket do not match, that indicates the end of the packet. The PLS\_DATA.indications for the last four octets are sent to the pMAC followed by PLS\_DATA\_VALID.indication(DATA\_NOT\_VALID). If the last four octets of the mPacket match, that indicates that the packet was preempted and the PLS\_DATA.indications for the last four octets are not sent to the pMAC. No further primitives are sent to the pMAC until the next mPacket of the packet is received.

An SMD containing an SMD-C indicates an mPacket that continues the data for a preempted packet.

Upon receiving an SMD value of SMD-C, Receive processing checks that:

- a) There is a preempted packet in progress,
- b) The frame count indicated by the SMD matches the frame count of the packet in progress, and
- c) The frag\_count value indicates the next fragment count.

If any of the checks fail, the mPacket is discarded and Receive processing ensures that the pMAC detects a FrameCheckError as previously described. Then PLS\_DATA\_VALID.indication(DATA\_NOT\_VALID) is sent to the pMAC.

If all the checks pass, the next fragment count is incremented modulo 4 and the PLS\_DATA.indications after the frag\_count field are sent to the pMAC.

Receive processing handles the last four octets of the mPacket as previously described.

Receive processing shall be performed as specified in Figure 99–6.

PLS\_SIGNAL.indication is never produced by Receive processing since it does not apply to full duplex PHYs.

#### 99.4.6 Express filter

The Express filter (see Figure 99–3) checks the SMD of each received mPacket. If an mPacket contains an SMD-E, the Express filter passes the RS PLS\_DATA.request to the eMAC. If the SMD contains any other value, Express filter ignores the mPacket.

Express processing shall be performed as specified in Figure 99–7.

PLS\_SIGNAL.indication is never produced by Express filter since it does not apply to full duplex PHYs.

## 99.4.7 Detailed functions and state diagrams

### 99.4.7.1 State diagram conventions

The body of this subclause is comprised of state diagrams, including the associated definitions of variables, constants, and functions. Should there be a discrepancy between a state diagram and descriptive text, the state diagram prevails.

The notation used in the state diagrams follows the conventions of 21.5. State diagram timers follow the conventions of 14.2.3.2. The notation ++ after a counter or integer variable indicates that its value is to be incremented.

PLS service interface primitives are prefixed by a letter to designate the PLS service interface as follows:

- e PLS service interface between the eMAC and MAC Merge sublayer
- p PLS service interface between the pMAC and MAC Merge sublayer
- r PLS service interface between MAC Merge sublayer and RS

For example, ePLS\_DATA.request is a PLS\_DATA.request primitive from the eMAC.

### 99.4.7.2 Constants

|             |  |
|-------------|--|
| minFrag     | the integer 64, the number of octets required for a minimum size fragment. |
| PREAMBLE    | 0x55   |
| SFD         | 0xD5   |
| verifyLimit | the integer 3, the number of verification attempts                         |

### 99.4.7.3 Variables

|               |  |
|---------------|--|
| addFragSize   | An integer in the range 0:3 that controls the minimum non-final mPacket length, as specified in 99.4.4. Set to the value of the addFragSize field in the received Additional Ethernet Capabilities TLV (see 79.3.7). |
| begin         | A Boolean variable that is set TRUE by implementation dependent means to initialize the state machines.  |
| cFrameCnt     | An integer in the range 0:3 set by the SMD_DECODE function invoked on the SMD-C of a continuation packet that indicates the frame count of the continuation mPacket.   |
| disableVerify | A Boolean variable that is set by management to control verification of preemption operation (see 99.4.3). TRUE disables verification and FALSE enables verification.  |
| eTx           | Boolean variable that is TRUE when an ePLS_DATA.request has been received and a corresponding rPLS_DATA.request has not yet been generated. FALSE otherwise.   |
| eTxCplt       | Boolean variable that is set TRUE when ePLS_DATA.request with the value DATA_COMPLETE is received and set FALSE when the end of frame has been processed.  |