

This is an *Archive IEEE Standard*. It has been withdrawn or superseded by a later version of the standard.

ARCHIVE STANDARDS MAY HAVE VALUE AS HISTORICAL DOCUMENTS, BUT THEY ARE NOT VALID OR APPROVED IEEE STANDARDS. THE IEEE SHALL NOT BE LIABLE FOR ANY DAMAGES RESULTING FROM THE SUBSCRIBER'S OR USERS' PRACTICE OF THIS UNAPPROVED, ARCHIVE IEEE STANDARD.

For more information about this or other current, revised or withdrawn standards, please consult the IEEE Standards Status report on-line at <http://standards.ieee.org/db/status/>.

Recognized as an
American National Standard (ANSI)

IEEE Std 802.3u-1995
(Supplement to ISO/IEC 8802-3: 1993
[ANSI/IEEE Std 802.3, 1993 Edition])

IEEE Standards for Local and Metropolitan Area Networks:

Supplement to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units, and Repeater for 100 Mb/s Operation, Type 100BASE-T (Clauses 21–30)

Sponsor

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

Approved 14 June 1995
IEEE Standards Board

Approved 4 April 1996
American National Standards Institute

2nd Printing, Corrected Edition

Abstract: The ISO/IEC CSMA/CD Media Access Control (MAC) is given an additional set of parameters for 100 Mb/s operation. A repeater and added Physical Layers, known collectively as 100BASE-T, as well as significant additional supporting material for a Media Independent Interface (MII), management, and automatic configuration, are specified. This includes 100BASE-T4, which uses four pairs of Category 3, 4, or 5 generic twisted, balanced cable; 100BASE-TX, which uses two pairs of Category 5 balanced cable or 150 Ω shielded balanced cable; and 100BASE-FX, which uses two multi-mode fibers. Fibre Distributed Data Interface (FDDI) media interface specifications are referenced to provide the 100BASE-TX and 100BASE-FX physical signaling channels, defined under the subcategory 100BASE-X.

Keywords: 100BASE-FX, 100BASE-T, 100BASE-T4, 100BASE-TX, 100BASE-X, Auto-Negotiation, Fast Ethernet, management, Media Independent Interface (MII), repeater

The Institute of Electrical and Electronics Engineers, Inc.
345 East 47th Street, New York, NY 10017-2394, USA

Copyright © 1995 by the Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 1995. Printed in the United States of America

ISBN 1-55937-542-6

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.

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

IEEE Standards documents are developed within the Technical Committees of the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Board. Members of the committees serve voluntarily and without compensation. They are not necessarily members of the Institute. The standards developed within IEEE represent a consensus of the broad expertise on the subject within the Institute as well as those activities outside of IEEE that have expressed an interest in participating in the development of the standard.

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. Every IEEE Standard is subjected to review at least every five years for revision or reaffirmation. When a document is more than five years old and has not been reaffirmed, 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.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of all concerned interests, it is important to ensure that any interpretation has also received the concurrence of a balance of interests. For this reason IEEE and the members of its technical committees are not able to provide an instant response to interpretation requests except in those cases where the matter has previously received formal consideration.

Comments on standards and requests for interpretations should be addressed to:

Secretary, IEEE Standards Board
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331
USA

Note: 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 with respect to the existence or validity of any patent rights in connection therewith. The IEEE shall not be responsible for identifying all patents for which a license may be required by an IEEE standard or for conducting inquiries into the legal validity or scope of those patents that are brought to its attention.

Authorization to photocopy portions of any individual standard for internal or personal use is granted by the Institute of Electrical and Electronics Engineers, Inc., provided that the appropriate fee is paid to Copyright Clearance Center. To arrange for payment of licensing fee, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; (508) 750-8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

Corrected Edition, June 1996

The following corrections have been made to this edition:

Page 23: The designation of reference [A5] has been corrected to ANSI/EIA/TIA 526-14-1990. *[Note that further updates to annex A can be found in ISO/IEC 8802-3: 1996.]*

Page 32: In the last line of text on the page, the word “fourth” has been corrected to “sixth.”

Page 174: In figure 24-11, the “BAD SSD” box text has been corrected. “RXD<3.0> \Leftarrow 1110” now reads “RXD<3:0> \Leftarrow 1110”.

Page 234: The page, containing subclauses 27.7.4.11 and 27.7.4.12, was inadvertently omitted from the first printing. It is now included.

Page 286: Under list item a), notes 2 and 3 were misnumbered and have been corrected. Also, references in notes 2 and 3 to table 29-2 have been corrected to table 29-3.

Page 301: In table 30-1d, “aAutoNegAdvertisedTechnologyAbilit” has been corrected to “aAutoNegAdvertisedTechnologyAbility”.

Page 312: In subclause 30.4.1.1.2, the reference to 20.2.2.3 for “other” has been corrected to 30.2.5.

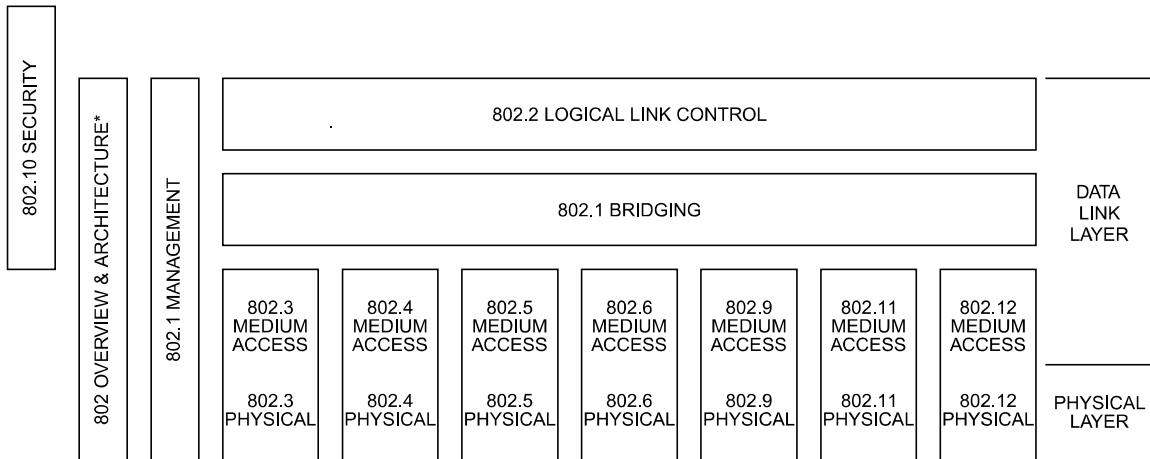
Page 323: In subclause 30.5.1.1.2, the reference to 20.2.2.3 for “other” has been corrected to 30.2.5.

Note that additional corrections are under consideration, and that some reference documents have been updated. These will be included in future maintenance documents.

Introduction

(This introduction is not part of IEEE Std 802.3u-1995.)

This standard is part of a family of standards for local and metropolitan area networks. The relationship between the standard and other members of the family is shown below. (The numbers in the figure refer to IEEE standard numbers.)



* Formerly IEEE Std 802.1A.

This family of standards deals with the Physical and Data Link layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection Basic Reference Model (ISO 7498 : 1984). The access standards define several types of medium access technologies and associated physical media, each appropriate for particular applications or system objectives. Other types are under investigation.

The standards defining the technologies noted above are as follows:

- IEEE Std 802¹: Overview and Architecture. This standard provides an overview to the family of IEEE 802 Standards. This document forms part of the 802.1 scope of work.
- ANSI/IEEE Std 802.1B [ISO/IEC 15802-2]: LAN/MAN Management. Defines an Open Systems Interconnection (OSI) management-compatible architecture, and services and protocol elements for use in a LAN/MAN environment for performing remote management.
- ANSI/IEEE Std 802.1D [ISO/IEC 10038]: MAC Bridging. Specifies an architecture and protocol for the interconnection of IEEE 802 LANs below the MAC service boundary.
- ANSI/IEEE Std 802.1E [ISO/IEC 15802-4]: System Load Protocol. Specifies a set of services and protocol for those aspects of management concerned with the loading of systems on IEEE 802 LANs.

¹The 802 Architecture and Overview standard, originally known as IEEE Std 802.1A, has been renumbered as IEEE Std 802. This has been done to accommodate recognition of the base standard in a family of standards. References to IEEE Std 802.1A should be considered as references to IEEE Std 802.

- ANSI/IEEE Std 802.2 [ISO/IEC 8802-2]: Logical Link Control
- ANSI/IEEE Std 802.3 [ISO/IEC 8802-3]: CSMA/CD Access Method and Physical Layer Specifications
- ANSI/IEEE Std 802.4 [ISO/IEC 8802-4]: Token Bus Access Method and Physical Layer Specifications
- ANSI/IEEE Std 802.5 [ISO/IEC 8802-5]: Token Ring Access Method and Physical Layer Specifications
- ANSI/IEEE Std 802.6 [ISO/IEC 8802-6]: Distributed Queue Dual Bus Access Method and Physical Layer Specifications
- IEEE Std 802.9: Integrated Services (IS) LAN Interface at the Medium Access Control (MAC) and Physical (PHY) Layers
- IEEE Std 802.10: Interoperable LAN/MAN Security, *Currently approved*: Secure Data Exchange (SDE)
- IEEE 802.12: Demand Priority Access Method/Physical Layer Specifications

In addition to the family of standards, the following is a recommended practice for a common Physical Layer technology:

- IEEE Std 802.7: IEEE Recommended Practice for Broadband Local Area Networks

The following additional working groups have authorized standards projects under development:

- IEEE 802.11: Wireless LAN Medium Access Control (MAC) Sublayer and Physical Layer Specifications
- IEEE 802.14: Standard Protocol for Cable-TV Based Broadband Communication Network

The reader of this standard is urged to become familiar with the complete family of standards.

Conformance test methodology

An additional standards series, identified by the number 1802, has been established to identify the conformance test methodology documents for the 802 family of standards. Thus the conformance test documents for 802.3 are numbered 1802.3, the conformance test documents for 802.5 will be 1802.5, and so on. Similarly, ISO will use 18802 to number conformance test standards for 8802 standards.

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

IEEE Std 802.3u-1995

At the time this standard (IEEE Std 802.3u-1995) was published, the IEEE 802.3 standard consisted of the following published documents:

- ISO/IEC 8802-3: 1993 [ANSI/IEEE Std 802.3, 1993 Edition]
- IEEE Std 802.3j-1993, Fiber Optic Active and Passive Star-Based Segments, Type 10BASE-F (Clauses 15–18)
- IEEE Std 802.3k-1992, Layer Management for 10 Mb/s Baseband Repeaters (Clause 19)
- IEEE Std 802.3l-1992, Type 10BASE-T Protocol Implementation Conformance Statement (PICS) Proforma (Subclause 14.10)
- IEEE Std 802.3p-1993 *and* IEEE Std 802.3q-1993, Guidelines for the Development of Managed Objects (GDMO) (ISO/IEC 10165-4) Format for Layer-Managed Objects (Clause 5) *and* Layer Management for 10 Mb/s Baseband Medium Attachment Units (MAUs) (Clause 20)
- IEEE Std 1802.3d-1993, Type 10BASE-T Medium Attachment Unit (MAU) (Conformance Test Methodology (Clause 6)

At the time this standard was published, there was revision and supplementary material that had been approved and scheduled for publication. Also, a new edition of ISO/IEC 8802-3 was in preparation to consolidate a significant amount of the above material. Information on the current state of this and other IEEE 802 standards may be obtained from

Secretary, IEEE Standards Board
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331
USA

IEEE 802 committee working documents are available from

IEEE Document Distribution Service
AlphaGraphics #35 Attn: P. Thrush
10201 N. 35th Avenue
Phoenix, AZ 85051
USA

Patent information

The IEEE Standards Board calls attention to the fact that it is claimed that portions of IEEE Std 802.3u-1995 are the subject of patents owned by a number of companies. The IEEE takes no position with respect to patent validity. Each of these companies has assured IEEE that it is willing to grant a license on these patents on reasonable and nondiscriminatory terms to anyone wishing to obtain such a license. The undertakings of these companies in this respect are on file with the IEEE Standards Department, and the license details may be obtained by contacting the Standards Department.

Participants

When the IEEE 802.3 Working Group approved IEEE Std 802.3u-1995, it had the following membership:

Geoffrey O. Thompson, *Chair*
Peter Tarrant, *Type 100BASE-T Task Force Chair, Phase 1*
Howard Frazier, *Type 100BASE-T Task Force Chair, Phase 2*
Paul Sherer, *Editor-in-Chief, Phase 1*
Howard Johnson, *Editor-in-Chief, Phase 2*
Colin Mick, *Comment Editor*

Martin Adams	Walter Hurwitz†	William Quackenbush
Don Aelmore	Ernie Jensen	Thomas J. Quigley
Paul Ahrens	Clarence Joh	Mohammad Rajabzadeh
Vish Akella	Anthony Jordan	Shlomo Rakib
Abe Ali	Dieter Junkers	Brian Ramelson
Nitish Amin	Omer Kal	Peter Rautenberg
Mike Armstrong	Ron Kao	Dennis Rehm
Denis Beaudoin	Yongbum Kim	Victor Renteria
Larry Birenbaum*	Srinivas Kola	Sean Riley
Mark Bohrer	Josef Kozilek	Gary Robinson
Paul Booth*	George Kubovcik	Khosrow Sadeghi
Samuel Bourche	Hans Lackner	David Schwartz
David Bourque	Erik Lander	Stephen Sedio
Sidney Bouzaglo	David Law*	Rich Seifert
Richard Bowers	Chun-Tsung Lee	Koichiro Seto
Richard Brand	Jack Lee	Chen-Chung Shih
Charles E. Brill	Vincent Lefebvre	Som Sikdar
Bill Bunch†	Richard Lewis	Charan J. Singh*
Peter Campbell	Sam Liang	Paramjeet (P. J.) Singh
Kiwon Chang	Chan-De Lin	Dinah Sloan
Samuel Chang	Chang-Chi Liu	Tom Slykhouse
Howard Charney	Terry Lockyer	Michael Smith
Hon Wah Chin	Ken Lu	Dror Sofer
Jacques Christ	Andy J. Luque	Gregory Somer
Ronald J. Cooper	Brian MacLeod	Walter Sotelo
Ron Crane	Kenneth MacLeod	Peter Staub
Ian Crayford*	Joseph Mazor	Ron Sulyma
Robert Curtis	Mike McConnell	Daniel Sze
Bernard Daines	John McCool	Martin Takessian
Sean Dingman	Tim McShane	Wen-Tsung Tang
Thuyen Dinh	Mart L. Molle	Tim Teckman
Dan Dove	Shimon Muller	Douglas Thomson
James Doyle	Samba Murthy	Nader Vijeh
Peter Ecclesine	Larry Nicholson	Moshe Voloshin
Dean Edwards	Paul Nikolich	Ikuo Wakayama
George Eisler	Ahmad Nouri	Chang Jung Wang
Nick Esser	J. Michael O'Connor	Yun-Che Wang
Jim Everitt	Lloyd Oliver	Ken Ward
David Fischer	Pat Overs	Bob Watson
Alan Flatman	Sandeep Patel	David Wong
Christian G. Folting	John Payne	Paul Woodruff*
Atsuhisa Fukuoka	Tony Peatfield	Nariman Yousefi
Wolfgang Heidasch		Jamie Zartman

* served as sub-task force chair or clause editor

† served as clause editor but was not a working group member at the time of ballot

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

The following persons were on the balloting committee:

Don Aelmore	Jacob J. Hsu	Thomas L. Phinney
Bernhard Albert	Howard Johnson	Kirk Preiss
Alan Albrecht	Gary C. Kessler	Alberto Profumo
Abe Ali	Mladen Kezunovic	Vikram Punj
Hasan S. Alkhatib	Yongbum Kim	Andris Putnins
Corey Anderson	Mikio Kiyono	Brian Ramelson
Kit Athul	Kenneth C. Kung	Fernando Ramos
William E. Ayen	David Law	Eugene J. Reilly
Kendall F. Barney	Lanse M. Leach	Everett O. Rigsbee
Larry Birenbaum	Sam Liang	Gary S. Robinson
Simon Black	Randolph S. Little	Philip T. Robinson
Kwame Boakye	Donald C. Loughry	James W. Romlein
Kathleen L. Briggs	Robert D. Love	Floyd E. Ross
Peter K. Campbell	William C. Lynch	S. I. Samoylenko
James T. Carlo	Peter Martini	Frederick E. Sauer
Alan J. Chwick	William C. McDonald	Frederick Scholl
Alistair Coles	Tim J. McShane	David Schwartz
Ian Crayford	Bennett Meyer	Mick Seaman
Robert S. Crowder	Colin K. Mick	John Selep
Joe Curcio	Ann Miller	Koichiro Seto
Ibibia K. Dabipi	Bruce D. Miller	Donald A. Sheppard
Robert Donnan	Richard H. Miller	Leo Sintonen
Daniel Dove	David S. Millman	William R. Smith
Edward A. Dunlop	Warren Monroe	Harry P. Solomon
John E. Emrich	John E. Montague	Robert K. Southard
Alvin W. Eng	Kinji Mori	Efstathios D. Sykas
Philip H. Enslow, Jr.	David J. Morris	Steven R. Taylor
Changxin Fan	James R. Moulton	Patricia Thaler
John W. Fendrich	Wayne D. Moyers	Geoffrey O. Thompson
David Fifield	Shimon Muller	Kaichi Tsuno
Michael Fischer	Paul Nikolich	Mark-Rene Uchida
Christian G. Folting	Ellis S. Nolley	Barry M. Vornbrock
Howard M. Frazier	Robert O'Hara	Yun-Che Wang
Harvey A. Freeman	Donal O'Mahony	Alan J. Weissberger
Robert J. Gagliano	Young Oh	Frank J. Weisser
D. G. Gan	Joerg Ottensmeyer	Raymond P. Wenig
Harry Gold	Roger Pandanda	Earl J. Whitaker
Patrick Gonia	Lalit Mohan Patnaik	Jerry A. Wyatt
Andrew Gruskay	Lucy W. Person	Oren Yuen

When the IEEE Standards Board approved this standard on June 14, 1995, it had the following membership:

E. G. “Al” Kiener, *Chair*

Donald C. Loughry, *Vice Chair*

Andrew G. Salem, *Secretary*

Gilles A. Baril
Clyde R. Camp
Joseph A. Cannatelli
Stephen L. Diamond
Harold E. Epstein
Donald C. Fleckenstein
Jay Forster*
Donald N. Heirman

Richard J. Holleman
Jim Isaak
Ben C. Johnson
Sonny Kasturi
Lorraine C. Kevra
Ivor N. Knight
Joseph L. Koepfinger*
D. N. “Jim” Logothetis
L. Bruce McClung

Marco W. Migliaro
Mary Lou Padgett
John W. Pope
Arthur K. Reilly
Gary S. Robinson
Ingo Rusch
Chee Kiow Tan
Leonard L. Tripp

*Member Emeritus

Also included are the following nonvoting IEEE Standards Board liaisons:

Satish K. Aggarwal
Richard B. Engelman
Robert E. Hebner
Chester C. Taylor

Kristin M. Dittmann
IEEE Standards Project Editor

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

Contents

CLAUSE	PAGE
Revisions to ISO/IEC 8802-3 : 1993 [ANSI/IEEE Std 802.3, 1993 Edition]	1
21. Introduction to 100 Mb/s baseband networks, type 100BASE-T	27
21.1 Overview	27
21.1.1 Reconciliation Sublayer (RS) and Media Independent Interface (MII)	27
21.1.2 Physical Layer signaling systems	27
21.1.3 Repeater	28
21.1.4 Auto-Negotiation	28
21.1.5 Management	28
21.2 Abbreviations	29
21.3 References	30
21.4 Definitions	30
21.5 State diagrams	30
21.5.1 Actions inside state blocks	30
21.5.2 State diagram variables	31
21.5.3 State transitions	31
21.5.4 Operators	31
21.6 Protocol Implementation Conformance Statement (PICS) proforma	32
21.6.1 Introduction	32
21.6.2 Abbreviations and special symbols	32
21.6.3 Instructions for completing the PICS proforma	32
21.6.4 Additional information	33
21.6.5 Exceptional information	33
21.6.6 Conditional items	33
21.7 Relation of 100BASE-T to other standards	34
21.8 MAC delay constraints (exposed MII)	35
22. Reconciliation Sublayer (RS) and Media Independent Interface (MII)	37
22.1 Overview	37
22.1.1 Summary of major concepts	38
22.1.2 Application	38
22.1.3 Rates of operation	39
22.1.4 Allocation of functions	39
22.2 Functional specifications	39
22.2.1 Mapping of MII signals to PLS service primitives and Station Management	39
22.2.2 MII signal functional specifications	42
22.2.3 Frame structure	48
22.2.4 Management functions	51
22.3 Signal timing characteristics	60
22.3.1 Signals that are synchronous to TX_CLK	61
22.3.2 Signals that are synchronous to RX_CLK	61
22.3.3 Signals that have no required clock relationship	62
22.3.4 MDIO timing relationship to MDC	62
22.4 Electrical characteristics	63
22.4.1 Signal levels	63
22.4.2 Signal paths	63
22.4.3 Driver characteristics	64
22.4.4 Receiver characteristics	65
22.4.5 Cable characteristics	66
22.4.6 Hot insertion and removal	67

This is an ^xArchive IEEE Standard. It has been superseded by a later version of this standard.

CLAUSE	PAGE
22.5	Power supply 67
22.5.1	Supply voltage 67
22.5.2	Load current 67
22.5.3	Short-circuit protection 67
22.6	Mechanical characteristics 68
22.6.1	Definition of mechanical interface 68
22.6.2	Shielding effectiveness and transfer impedance 68
22.6.3	Connector pin numbering 69
22.6.4	Clearance dimensions 69
22.6.5	Contact assignments 70
22.7	Protocol Implementation Conformance Statement (PICS) proforma for clause 22, Reconciliation Sublayer (RS) and Media Independent Interface (MII) 71
22.7.1	Introduction 71
22.7.2	Identification 71
22.7.3	PICS proforma tables for reconciliation sublayer and media independent interface 72
23.	Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 100BASE-T4 81
23.1	Overview 81
23.1.1	Scope 81
23.1.2	Objectives 81
23.1.3	Relation of 100BASE-T4 to other standards 81
23.1.4	Summary 81
23.1.5	Application of 100BASE-T4 84
23.2	PCS functional specifications 85
23.2.1	PCS functions 85
23.2.2	PCS interfaces 90
23.2.3	Frame structure 90
23.2.4	PCS state diagrams 91
23.2.5	PCS electrical specifications 99
23.3	PMA service interface 99
23.3.1	PMA_TYPE.indicate 100
23.3.2	PMA_UNITDATA.request 100
23.3.3	PMA_UNITDATA.indicate 101
23.3.4	PMA_CARRIER.indicate 102
23.3.5	PMA_LINK.indicate 102
23.3.6	PMA_LINK request 103
23.3.7	PMA_RXERROR.indicate 104
23.4	PMA functional specifications 104
23.4.1	PMA functions 104
23.4.2	PMA interface messages 108
23.4.3	PMA state diagrams 109
23.5	PMA electrical specifications 112
23.5.1	PMA-to-MDI interface characteristics 112
23.5.2	Power consumption 124
23.6	Link segment characteristics 125
23.6.1	Cabling 125
23.6.2	Link transmission parameters 125
23.6.3	Noise 127
23.6.4	Installation practice 128

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

CLAUSE	PAGE
23.7	MDI specification 129
23.7.1	MDI connectors 129
23.7.2	Crossover function 130
23.8	System considerations 130
23.9	Environmental specifications 130
23.9.1	General safety 130
23.9.2	Network safety 130
23.9.3	Environment 132
23.10	PHY labeling 132
23.11	Timing summary 133
23.11.1	Timing references 133
23.11.2	Definitions of controlled parameters 134
23.11.3	Table of required timing values 136
23.12	Protocol Implementation Conformance Statement (PICS) proforma for clause 23, Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 100BASE-T4 143
23.12.1	Introduction 143
23.12.2	Identification 143
23.12.3	Major capabilities/options 144
23.12.4	PICS proforma tables for the Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 100BASE-T4 144
24.	Physical Coding Sublayer (PCS) and Physical Medium Attachment (PMA) sublayer, type 100BASE-X 157
24.1	Overview 157
24.1.1	Scope 157
24.1.2	Objectives 157
24.1.3	Relationship of 100BASE-X to other standards 157
24.1.4	Summary of 100BASE-X sublayers 157
24.1.5	Inter-sublayer interfaces 159
24.1.6	Functional block diagram 159
24.1.7	State diagram conventions 159
24.2	Physical Coding Sublayer (PCS) 160
24.2.1	Service Interface (MII) 160
24.2.2	Functional requirements 160
24.2.3	State variables 167
24.2.4	State diagrams 169
24.3	Physical Medium Attachment (PMA) sublayer 173
24.3.1	Service interface 173
24.3.2	Functional requirements 178
24.3.3	State variables 179
24.3.4	Process specifications and state diagrams 181
24.4	Physical Medium Dependent (PMD) sublayer service interface 184
24.4.1	PMD service interface 184
24.4.2	Medium Dependent Interface (MDI) 187
24.5	Compatibility considerations 187
24.6	Delay constraints 188
24.6.1	PHY delay constraints (exposed MII) 188
24.6.2	DTE delay constraints (unexposed MII) 188
24.6.3	Carrier de-assertion/assertion constraint 188
24.7	Environmental specifications 188

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

24.8 Protocol Implementation Conformance Statement (PICS) proforma for clause 24,
Physical Coding Sublayer (PCS) and Physical Medium Attachment (PMA) sublayer,
type 100BASE-X 190

24.8.1 Introduction 190

24.8.2 Identification 190

24.8.3 PICS proforma tables for the Physical Coding Sublayer (PCS) and
Physical Medium Attachment (PMA) sublayer, type 100BASE-X..... 191

25. Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX 193

25.1 Overview 193

25.2 Functional specifications 193

25.3 General exceptions 193

25.4 Specific requirements and exceptions 194

25.4.1 Change to 7.2.3.1.1, “Line state patterns” 194

25.4.2 Change to 7.2.3.3, “Loss of synchronization” 194

25.4.3 Change to table 8-1, “Contact assignments for unshielded twisted pair” 194

25.4.4 Deletion of 8.3, “Station labelling” 194

25.4.5 Change to 9.1.9, “Jitter” 194

25.4.6 Replacement of 11.2, “Crossover function” 195

25.4.7 Change to A.2, “DDJ test pattern for baseline wander measurements” 195

25.4.8 Change to annex G, “Stream cipher scrambling function” 195

25.4.9 Change to annex I, “Common mode cable termination” 195

25.5 Protocol Implementation Conformance Statement (PICS) proforma for clause 25,
Physical Medium Dependent (PMD) sublayer and baseband medium,
type 100BASE-TX 196

25.5.1 Introduction 196

25.5.2 Identification 196

25.5.3 Major capabilities/options 197

25.5.4 PICS proforma tables for the Physical Medium Dependent (PMD) sublayer
and baseband medium, type 100BASE-TX 197

26. Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-FX 199

26.1 Overview 199

26.2 Functional specifications 199

26.3 General exceptions 199

26.4 Specific requirements and exceptions 200

26.4.1 Medium Dependent Interface (MDI) 200

26.4.2 Crossover function 200

26.5 Protocol Implementation Conformance Statement (PICS) proforma for clause 26,
Physical Medium Dependent (PMD) sublayer and baseband medium,
type 100BASE-FX 201

26.5.1 Introduction 201

26.5.2 Identification 201

26.5.3 Protocol summary 201

26.5.4 Major capabilities/options 202

26.5.5 PICS proforma tables for Physical Medium Dependent (PMD) sublayer
and baseband medium, type 100BASE-FX 202

CLAUSE	PAGE
27. Repeater for 100 Mb/s baseband networks	203
27.1 Overview	203
27.1.1 Scope	203
27.1.2 Application perspective	204
27.1.3 Relationship to PHY	205
27.2 PMA interface messages	205
27.3 Repeater functional specifications	205
27.3.1 Repeater functions	206
27.3.2 Detailed repeater functions and state diagrams	210
27.4 Repeater electrical specifications	224
27.4.1 Electrical isolation	224
27.5 Environmental specifications	224
27.5.1 General safety	224
27.5.2 Network safety	224
27.5.3 Electrical isolation	225
27.5.4 Reliability	225
27.5.5 Environment	226
27.6 Repeater labeling	226
27.7 Protocol Implementation Conformance Statement (PICS) proforma for clause 27, Repeater for 100 Mb/s baseband networks	227
27.7.1 Introduction	227
27.7.2 Identification	227
27.7.3 Major capabilities/options	228
27.7.4 PICS proforma tables for the Repeater for 100 Mb/s baseband networks	228
28. Physical Layer link signaling for 10 Mb/s and 100 Mb/s Auto-Negotiation on twisted pair	235
28.1 Overview	235
28.1.1 Scope	235
28.1.2 Application perspective/objectives	236
28.1.3 Relationship to ISO/IEC 8802-3	236
28.1.4 Compatibility considerations	237
28.2 Functional specifications	238
28.2.1 Transmit function requirements	239
28.2.2 Receive function requirements	242
28.2.3 Arbitration function requirements	244
28.2.4 Management function requirements	248
28.2.5 Absence of management function	253
28.2.6 Technology-Dependent Interface	253
28.3 State diagrams and variable definitions	255
28.3.1 State diagram variables	255
28.3.2 State diagram timers	260
28.3.3 State diagram counters	262
28.3.4 State diagrams	263
28.4 Electrical specifications	266
28.5 Protocol Implementation Conformance Statement (PICS) proforma for clause 28, Physical Layer link signaling for 10 Mb/s and 100 Mb/s Auto-Negotiation on twisted pair	267
28.5.1 Introduction	267
28.5.2 Identification	267
28.5.3 Major capabilities/options	268
28.5.4 PICS proforma tables for Physical Layer link signaling for 10 Mb/s and 100 Mb/s Auto-Negotiation on twisted pair	268
28.6 Auto-Negotiation expansion	280

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

CLAUSE	PAGE
29. System considerations for multi-segment 100BASE-T networks	281
29.1 Overview	281
29.1.1 Single collision domain multi-segment networks	282
29.1.2 Repeater usage	283
29.2 Transmission System Model 1	283
29.3 Transmission System Model 2	283
29.3.1 Round-trip collision delay	285
30. Layer Management for 10 Mb/s and 100 Mb/s	289
30.1 Overview	289
30.1.1 Scope	290
30.1.2 Relationship to objects in IEEE Std 802.1F-1993	290
30.1.3 Systems management overview	290
30.1.4 Management model	291
30.2 Managed objects	292
30.2.1 Introduction	292
30.2.2 Overview of managed objects	292
30.2.3 Containment	295
30.2.4 Naming	296
30.2.5 Capabilities	296
30.3 Layer management for 10 Mb/s and 100 Mb/s DTEs	302
30.3.1 MAC entity managed object class	302
30.3.2 PHY entity managed object class	309
30.4 Layer management for 10 Mb/s and 100 Mb/s baseband repeaters	312
30.4.1 Repeater managed object class	312
30.4.2 Group managed object class	316
30.4.3 Repeater port managed object class	317
30.5 Layer management for 10 Mb/s and 100 Mb/s MAUs	322
30.5.1 MAU managed object class	322
30.6 Management for link Auto-Negotiation	326
30.6.1 Auto-Negotiation managed object class	326
 ANNEXES	
22A (informative) MII output delay, setup, and hold time budget	331
22B (informative) MII driver ac characteristics	334
22C (informative) Measurement techniques for MII signal timing characteristics	336
23A (normative) 6T code words	338
23B (informative) Noise budget	340
23C (informative) Use of cabling systems with a nominal differential characteristic impedance of 120 Ω	341
27A (normative) Repeater delay consistency requirements	342
28A (normative) Selector Field definitions	343

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

ANNEXES	PAGE
28B (normative) IEEE 802.3 Selector Base Page definition	344
28C (normative) Next Page Message Code Field definitions	346
29A (informative) DTE and repeater delay components	348
29B (informative) Recommended topology documentation	349
30A (normative) GDMO specification for 802.3 managed object classes	350
30B (normative) GDMO and ASN.1 definitions for management	389

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

xvi

IEEE Standards for Local and Metropolitan Area Networks:

Supplement to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

Revisions to ISO/IEC 8802-3 : 1993 [ANSI/IEEE Std 802.3, 1993 Edition]

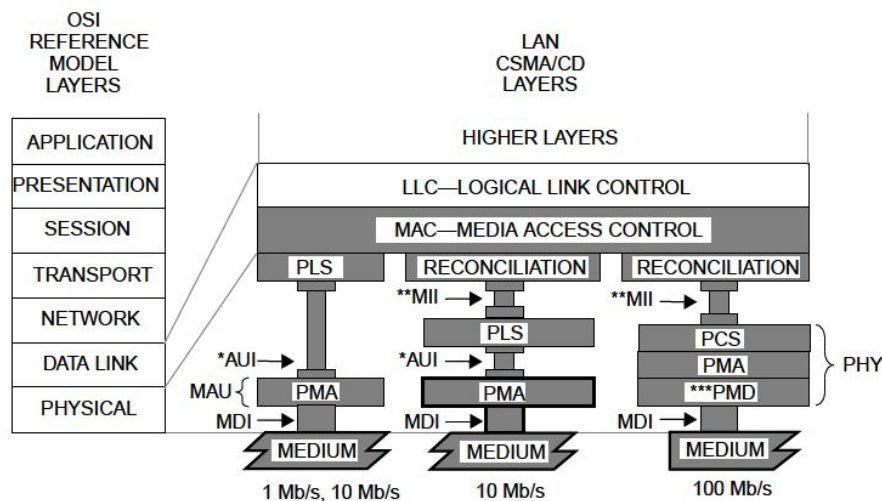
EDITORIAL NOTES

1—The following changes to ISO/IEC 8802-3 : 1993 [ANSI/IEEE Std 802.3, 1993 Edition] (and supplements 802.3j-1993, 802.3k-1992, 802.3l-1992, and 802.3p&q-1993) affect clauses 1, 2, 4, 5, 14, 19, 20, Annex A, and Annex D. These changes must also be applied to the 1995 edition of ISO/IEC 8802-3, which will incorporate all the supplements.

2—The text as shown includes editorial changes that accommodate recent changes to the IEEE style.

3—Editing instructions are shown in *bold italic* type. Where modifications are made to paragraphs of existing text, deletions are shown in ~~strikethrough type~~ and additions are underlined. Editorial notes will not be carried over into future editions.

Replace figure 1-1 with the following:



AUI = ATTACHMENT UNIT INTERFACE
 MDI = MEDIUM DEPENDENT INTERFACE
 MII = MEDIA INDEPENDENT INTERFACE
 MAU = MEDIUM ATTACHMENT UNIT

PLS = PHYSICAL LAYER SIGNALING
 PCS = PHYSICAL CODING SUBLAYER
 PMA = PHYSICAL MEDIUM ATTACHMENT
 PHY = PHYSICAL LAYER DEVICE
 PMD = PHYSICAL MEDIUM DEPENDENT

NOTE—The three types of layers below the MAC sublayer are mutually independent.

* AUI is optional for 10 Mb/s systems and is not specified for 1 Mb/s and 100 Mb/s systems.

** MII is optional for 10 Mb/s DTEs and for 100 Mb/s systems and is not specified for 1 Mb/s systems.

*** PMD is specified for 100BASE-X only; 100BASE-T4 does not use this layer.

For an exposed AUI residing below an MII, see 22.5.

Figure 1-1—LAN standard relationship to the ISO Opens Systems Interconnection (OSI) reference model

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.