IEEE Standards

IEEE Std 802.3aj™-2003
(Amendment to IEEE Std 802.3™-2002)

802.3aj™

IEEE Standard for Information technology— Telecommunications and information exchange between systems— Local and metropolitan area networks— Specific requirements

Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

Amendment: Maintenance 7

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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Approved 11 September 2003

IEEE-SA Standards Board

Abstract: This amendment to IEEE Std 802.3-2002, as amended by IEEE Std 802.3ae-2002 10Gb/s Ethernet and IEEE Std 802.3af-2003 DTE Power via MDI, contains a set of maintenance requests approved for ballot at the November 2002 IEEE 802.3 closing plenary as part of project IEEE P802.3aj Maintenance 7.

Keywords: 802.3aj, 1000BASE-T, Auto-Negotiation, Maintenance 7, Next Page

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Introduction to IEEE Std 802.3aj-2003

(This introduction is not part of IEEE Std 802.3aj-2003, IEEE Standard for Information technology— Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements CSMA/CD Access Method and Physical Layer Specifications Amendment: Maintenance 7.)

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 802.3ae). A historical listing of all projects that have added to or modified IEEE Std 802.3 follows as a part of this introductory material. The listing is in chronological order of project initiation and for each project describes: subject, clauses added (if any), approval dates, and committee officers.

The media access control (MAC) protocol specified in IEEE Std 802.3 is Carrier Sense Multiple Access with Collision Detection (CSMA/CD). This MAC protocol was included in the experimental Ethernet developed at Xerox Palo Alto Research Center. While the experimental Ethernet had a 2.94 Mb/s data rate, IEEE Std 802.3-1985 specified operation at 10 Mb/s. Since 1985 new media options, new speeds of operation, and new protocol capabilities have been added to IEEE Std 802.3.

Some of the major additions to IEEE Std 802.3 are identified 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 802.3x specified full duplex operation and a flow control protocol, IEEE Std 802.3z added 1000 Mb/s operation (also called Gigabit Ethernet) and IEEE Std 802.3ad specified link aggregation. These major additions are all now included in IEEE Std 802.3-2002 and are not available as separate documents.

Recent additions such as IEEE Std 802.3ae (also called 10 Gigabit Ethernet) and IEEE Std 802.3af (also called Power over Ethernet) are currently published as separate documents. These recent amendments are part of IEEE Std 802.3 and they are dependent on and reference information published in IEEE Std 802.3-2002.

At the date of IEEE Std 802.3aj publication, IEEE Std 802.3 is comprised of the following documents:

IEEE Std 802.3-2002

Section One—Includes Clause 1 through Clause 20 and Annexes A through H. 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 Clause32 and Annexes 22A through 32A. Section Two includes the specifications for 100 Mb/s operation and management attributes for multiple protocols and operational speeds.

Section Three—Includes Clause 34 through Clause 43 and Annexes 36A through 43C. Section Three includes the specifications for 1000 Mb/s operation.

IEEE Std 802.3ae-2002

Includes changes to IEEE Std 802.3-2002, and adds Clauses 44 through 53 and Annexes 44A through 50A. This amendment includes specifications for 10 Gb/s operation.

IEEE Std 802.3af-2003

Includes changes to IEEE Std 802.3-2002, and adds Clause 33 and Annexes 33A through 33E. This amendment includes specifications for the provision of power over 10BASE-T, 100BASE-TX and 1000BASE-T cabling.

IEEE Std 802.3aj-2003

Includes changes to IEEE Std 802.3-2002 and IEEE Std 802.3ae-2002.

IEEE 802.3 will continue to evolve. Revisions are anticipated to the above standards within the next few years to integrate approved changes into IEEE 802.3, to clarify existing material, to correct possible errors, and to incorporate new related material.

Conformance test methodology

An additional standard, IEEE Std 1802.3™ provides conformance test information for 10BASE-T.

IEEE Std 802.3aj-2003

IEEE Std 802.3aj-2003, Maintenance 7 is an amendment to IEEE Std 802.3. It includes corrections and clarifications to both IEEE Std 802.3-2002 and IEEE Std 802.3ae. In a few cases text published in IEEE Std 802.3-2002 is modified by IEEE Std 802.3ae-2002 and is subsequently modified by IEEE Std 802.3aj-2003. IEEE Std 802.3aj-2003 does not include any modifications to the text of IEEE Std 802.3af-2003.

Historical listing of IEEE Std 802.3 projects

Included in IEEE Std 802.3-2002

IEEE Std 802.3 document	Date approved by IEEE and ANSI	Officers at the time of working group ballot
802.3-1985, Original 10 Mb/s standard, MAC, PLS, AUI, 10BASE5	23 June 1983 (IEEE) 31 December 1984 (ANSI)	**Donald C. Loughry,** *Working Group Chair*
802.3a-1988 (Clause 10), 10 Mb/s MAU 10BASE2	15 November 1985 (IEEE) 28 December 1987 (ANSI)	**Donald C. Loughry,** *Working Group Chair* **Alan Flatman,** *Task Force Chair*
802.3b-1985 (Clause 11), 10 Mb/s Broadband MAU, 10BROAD36	19 September 1985 (IEEE) 28 February 1986 (ANSI)	**Donald C. Loughry,** *Working Group Chair* **Menachem Abraham,** *Task Force Chair*
802.3c-1985 (9.1–9.8), 10 Mb/s Baseband Repeater	12 December 1985 (IEEE) 4 June 1986 (ANSI)	**Donald C. Loughry,** *Working Group Chair* **Geoffrey O. Thompson,** *Task Force Chair*
802.3d-1987 (9.9), 10 Mb/s Fiber MAU, FOIRL	10 December 1987 (IEEE) 9 February 1989 (ANSI)	**Donald C. Loughry,** *Working Group Chair* **Steven Moustakas,** *Task Force Chair*
802.3e-1987 (Clause 12), 1 Mb/s MAU and Hub 1BASE5	11 June 1987 (IEEE) 15 December 1987 (ANSI)	**Donald C. Loughry,** *Working Group Chair* **Robert Galin,** *Task Force Chair*
802.3h-1990 (Clause 5), 10 Mb/s Layer Management, DTEs	28 September 1990 (IEEE) 11 March 1991 (ANSI)	**Donald C. Loughry,** *Working Group Chair* **Andy J. Luque,** *Task Force Chair*
802.3i-1990 (Clauses 13 and 14), 10 Mb/s UTP MAU, 10 BASE-T	28 September 1990 (IEEE) 11 March 1991 (ANSI)	**Donald C. Loughry**, *Working Group Chair* **Patricia Thaler,** *Task Force Chair (initial)* **Richard Anderson,** *Task Force Chair (final)*
802.3j-1993 (Clauses 15–18), 10 Mb/s Fiber MAUs 10BASE-FP, FB, and FL	15 September 1993 (IEEE) 15 March 1994 (ANSI)	**Patricia Thaler,** *Working Group Chair* **Keith Amundsen,** *Task Force Chair (initial)* **Frederick Scholl,** *Task Force Chair (final)* **Michael E. Lee,** *Technical Editor*
802.3k-1993 (Clause 19), 10 Mb/s Layer Management, Repeaters	17 September 1992 (IEEE) 8 March 1993 (ANSI)	**Patricia Thaler,** *Working Group Chair* **Joseph S. Skorupa,** *Task Force Chair* **Geoffrey O. Thompson,** *Vice Chair and Editor*

IEEE Std 802.3 document	Date approved by IEEE and ANSI	Officers at the time of working group ballot
802.3*l*-1992 (14.10), 10 Mb/s PICS Proforma 10BASE-T MAU	17 September 1992 (IEEE) 23 February 1993 (ANSI)	**Patricia Thaler,** *Working Group Chair* **Mike Armstrong,** *Task Force Chair and Editor* **Paul Nikolich,** *Vice Chair* **William Randle,** *Editorial Coordinator*
802.3m-1995, Maintenance 2	21 September 1995 (IEEE) 16 July 1996 (ANSI)	**Patricia Thaler,** *Working Group Chair* **Gary Robinson,** *Maintenance Chair*
802.3n-1995, Maintenance 3	21 September 1995 (IEEE) 4 April 1996 (ANSI)	**Patricia Thaler,** *Working Group Chair* **Gary Robinson,** *Maintenance Chair*
802.3p-1993™ (Clause 20), Management, 10 Mb/s Integrated MAUs	17 June 1993 (IEEE) 4 January 1994 (ANSI)	**Patricia Thaler,** *Working Group Chair* **Joseph S. Skorupa,** *Task Force Chair* **Geoffrey O. Thompson,** *Vice Chair and Editor*
802.3q-1993™ (Clause 5), 10 Mb/s Layer Management, GDMO Format	17 June 1993 (IEEE) 4 January 1994 (ANSI)	**Patricia Thaler,** *Working Group Chair* **Joseph S. Skorupa,** *Task Force Chair* **Geoffrey O. Thompson,** *Vice Chair and Editor*
802.3r-1996 (8.8), Type 10BASE5 Medium Attachment Unit PICS proforma	29 July 1996 (IEEE) 6 January 1997 (ANSI)	**Patricia Thaler,** *Working Group Chair* **Imre Juhász**, *Task Force Chair* **William Randle,** *Task Force Editor*
802.3s-1995, Maintenance 4	21 September 1995 (IEEE) 8 April 1996 (ANSI)	**Geoffrey O. Thompson,** *Working Group Chair* **Gary Robinson,** *Maintenance Chair*
802.3t-1995, 120 Ω informative annex to 10BASE-T	14 June 1995 (IEEE) 12 January 1996 (ANSI)	**Geoffrey O. Thompson,** *Working Group Chair* **Jacques Christ,** *Task Force Chair*
802.3u-1995 (Clauses 21–30), Type 100BASE-T MAC parameters, Physical Layer, MAUs, and Repeater for 100 Mb/s Operation	14 June 1995 (IEEE) 4 April 1996 (ANSI)	**Geoffrey O. Thompson,** *Working Group Chair* **Peter Tarrant,** *Task Force Chair (Phase 1)* **Howard Frazier,** *Task Force Chair (Phase 2)* **Paul Sherer,** *Editor-in-Chief (Phase 1)* **Howard Johnson,** *Editor-in-Chief (Phase 2)* **Colin Mick,** *Comment Editor*
802.3v-1995, 150 Ω informative annex to 10BASE-T	12 December 1995 (IEEE) 16 July 1996 (ANSI)	**Geoffrey O. Thompson,** *Working Group Chair* **Larry Nicholson,** *Task Force Chair*
802.3x-1997 and 802.3y-1997 (Revisions to 802.3, Clauses 31 and 32), Full Duplex Operation and Type 100BASE-T2	20 March 1997 (IEEE) 5 September 1997 (ANSI)	**Geoffrey O. Thompson,** *Working Group Chair* **David J. Law,** *Working Group Vice Chair* **Rich Seifert,** *Task Force Chair and Editor (802.3x)* **J. Scott Carter,** *Task Force Chair (802.3y)* **Colin Mick**, *Task Force Editor (802.3y)*
802.3z-1998™ (Clauses 34–39, 41–42), Type 1000BASE-X MAC Parameters, Physical Layer, Repeater, and Management Parameters for 1000 Mb/s Operation	25 June 1998 (IEEE)	**Geoffrey O. Thompson,** *Working Group Chair* **David J. Law,** *Working Group Vice Chair* **Howard M. Frazier, Jr.,** *Task Force Chair and Editor* **Howard W. Johnson,** *Task Force Editor*
802.3aa-1998, Maintenance 5	25 June 1998 (IEEE)	**Geoffrey O. Thompson,** *Working Group Chair* **Colin Mick**, *Task Force Editor (100BASE-T Maintenance)*
802.3ab-1999 (Clause 40), Physical Layer Parameters and Specifications for 1000 Mb/s Operation Over 4 Pair of Category 5 Balanced Copper Cabling, Type 1000BASE-T	26 June 1999 (IEEE)	**Geoffrey O. Thompson,** *Working Group Chair* **David J. Law,** *Working Group Vice Chair* **Robert M. Grow,** *Working Group Secretary* **George Eisler**, *Task Force Chair* **Colin Mick**, *Task Force Editor*

IEEE Std 802.3 document	Date approved by IEEE and ANSI	Officers at the time of working group ballot
802.3ac-1998, Frame Extensions for Virtual Bridged Local Area Network (VLAN) Tagging on 802.3 Networks	16 September 1998 (IEEE)	**Geoffrey O. Thompson,** *Working Group Chair* **David J. Law,** *Working Group Vice Chair* **Andy J. Luque,** *Working Group Secretary* **Ian Crayford,** *Task Force Chair* **Rich Seifert,** *Task Force Editor*
802.3ad-2000 (Clause 43), Aggregation of Multiple Link Segments	30 March 2000 (IEEE)	**Geoffrey O. Thompson,** *Working Group Chair* **David J. Law,** *Working Group Vice Chair* **Robert M. Grow,** *Working Group Secretary* **Steven Haddock,** *Task Force Chair* **Tony Jeffree,** *Co-Editor* **Rich Seifert,** *CoEditor*
802.3-2002 (802.3ag, Maintenance 6, Revision of the base), Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications	14 January 2002 (IEEE)	**Geoffrey O. Thompson,** *Working Group Chair* **David J. Law,** *Working Group Vice Chair* **Robert M. Grow,** *Working Group Secretary*

Temporarily published as separate documents

IEEE Std 802.3 document	Date approved by IEEE and ANSI	Officers at the time of working group ballot
802.3ae-2002,(Clauses 44–53) Media Access Control (MAC) Parameters, Physical Layers, and Management Parameters for 10 Gb/s Operation	13 June 2002 (IEEE)	**Geoffrey O. Thompson,** *Working Group Chair* **David J. Law,** *Working Group Vice Chair* **Robert M. Grow,** *Working Group Secretary* **R. Jonathan Thatcher,** *Task Force Chair* **Stephen Haddock,** *Task Force Vice Chair* **Bradley J. Booth,** *Task Force Editor* **Lacreshia Laningham,** *Task Force Assistant Editor* **Benjamin Brown,** *Logic Track Chair* **Walter Thirion,** *Optical Track Chair*
802.3af-2003, (Clause 33) Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)	12 June 2003 (IEEE)	**Geoffrey O. Thompson,** *Working Group Chair—Phase 1* **Robert M. Grow,** *Working Group Chair—Phase 2* **David J. Law,** *Working Group Vice Chair* **Robert M. Grow,** *Secretary—Phase 1* **Steven B. Carlson,** *Secretary—Phase 2* **Steven B. Carlson,** *Task Force Chair* **Michael S. McCormack,** *Editor—Phase 1* **John J. Jetzt,** *Editor—Phase 2* **Chad M. Jones,** *Comment Editor*
802.3aj-2003, Maintenance 7	11 September 2003 (IEEE)	**Robert M. Grow,** *Working Group Chair* **David J. Law,** *Working Group Vice Chair, Task Force Chair* **Steven B. Carlson,** *Working Group Secretary* **Catherine K. N. Berger,** *Task Force Editor*

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Also included are the following nonvoting IEEE-SA Standards Board liaisons:

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Contents

List of special symbols

For the benefit of those who have received this document by electronic means, what follows is a list of special symbols and operators. If any of these symbols or operators fail to display or print out correctly, the editors hope that this table will aid in interpreting any funny blobs and strokes appearing in the body of the document.

Special symbols and operators

Printed Character	Meaning	Font
∗	Boolean AND	Symbol
+	Boolean OR, Arithmetic addition	Symbol
^	Boolean XOR	Times
!	Boolean NOT	Symbol
<	Less than	Symbol
≤	Less than or equal to	Symbol
=	Equal to	Symbol
≠	Not equal to	Symbol
≥	Greater than or equal to	Symbol
>	Greater than	Symbol
⇐	Assignment operator	Symbol
∈	Indicates membership	Symbol
∉	Indicates nonmembership	Symbol
±	Plus or minus (a tolerance)	Symbol
°	Degrees (as in degrees Celsius)	Symbol
∑	Summation	Symbol
—	Big dash (Em dash)	Times
–	Little dash (En dash)	Times
†	Dagger	Times
‡	Double dagger	Times

IEEE Standard for Information technology—
Telecommunications and information exchange between systems—
Local and metropolitan area networks—
Specific requirements—

Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

Amendment: Maintenance 7

[These changes are part of IEEE Std 802.3™-2002.]

EDITORIAL NOTE—This amendment is based on the current edition of IEEE Std 802.3-2002 as amended by IEEE Std 802.3ae-2002 and IEEE Std 802.3af-2003. The editing instructions define how to merge the material contained here into this base document set to form the new comprehensive standard as created by the addition of IEEE Std 802.3aj-2003. (This standard does not modify any text of IEEE Std 802.3af-2003.)

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

1. Introduction

1.3 Normative references

Delete the following reference from 1.3:

ANSI X3.237-1995, Rev 2.1 (1 January 1995), FDDI Low-Cost Fibre Physical Layer—Medium Dependent (LCF-PMD) (ISO/IEC CD 9314-9).

Change the references in 1.3 and associateds footnotes as follows (entries should be placed in subclause in alphabetical order):

ANSI/TIA/EIA-568-B:2001, Commercial Building Telecommunications Cabling Standard.

IEEE Std 802.1Q-1998,~~P802.1Q/D11™ (July 30, 1998), Draft~~ IEEE Standard for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks.~~[1]~~

IEEE Std 802a™-2003, IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture —Amendment 1: Ethertypes for prototype and vendor-specific protocol development.

IETF RFC 1155, Structure and Identification of Management Information for TCP/IP-based Internets, Rose, M., and K. McCloghrie, May 1990.[1]

ISO/IEC 11801:1995, Information technology—Generic cabling for customer premises.[2]

ISO/IEC 11801:2002, Information technology—Generic cabling for customer premises.

1.4 Definitions

Change definition 1.4.120 as follows:

1.4.120 Fiber Optic Inter-Repeater Link (FOIRL) bit error ~~rate~~ ratio (BER): For 10BASE-F, the mean bit error ~~rate~~ ratio of the FOIRL. (See IEEE 802.3 Clause 9.)

[1]~~IEFT~~ IETF RFCs are available from the Internet Engineering Task Force website at http://www.ietf.org/rfc.html.

[2]Previous editions of ISO/IEC standards are available from Deutsches Institut für Normung, Burggrafenstrasse 6, 10787 Berlin, Germany (www.din.de).

3. Media access control frame structure

3.2.6 Length/Type field

Insert the following note to the end of 3.2.6:

NOTE—Clause 12 of IEEE Std 802a-2003 (an amendment to IEEE Std 802) defines a set of Type values and associated mechanisms for use in prototype and vendor-specific protocol development.

4. Media Access Control

4.4.2 Allowable implementations

Delete 4.4.2.1 through 4.4.2.4 (as modified by IEEE Std 802.3ae-2002).

5. Layer Management

5.2.4.1 Common constants and types

Change 5.2.4.1 as follows:

The following are the common constants and types required for the Layer Management procedures:

const

maxUntaggedFrameSize = ... ; {in octets, implementation-dependent, see 4.4}
maxDeferTime = …; {2 × (maxUntaggedFrameSize × 8), for operating speeds of 100 Mb/s and below, and 2 × (burstLimit + maxUntaggedFrameSize × 8 + headerSize) for operating speeds greater than 100 Mb/s, in bits, error timer limit for maxDeferTime}
maxLarge = 4294967295; {maximum value (2^{32} – 1) of wraparound 32-bit counter}
max64 = 18446744073709551615; {maximum value (2^{64} – 1) of wraparound 64-bit counter}
oneBitTime = 1; {the period it takes to transmit one bit}

type

CounterLarge = 0..maxLarge; – S{see footnote[3]}.;

[3]The CounterLarge declaration is an example of how to declare a counter. This particular example produces a 32 bit counter.

7. Physical Signaling (PLS) and Attachment Unit Interface (AUI) specifications

7.2.4.6 Carrier Sense function

Change the footnote associated with the first paragraph of 7.2.4.6 as follows:

The PLS sublayer Carrier Sense function performs the task of sending carrierSense and sqeTestError to the MAC sublayer. The state diagram of Figure 7–8 depicts the Carrier Sense function operation.[4]

[4]Formerly, this function utilized the variable output_in_~~progress~~process generated by the PLS output function described in Figure 7–5. For the sake of consistency with common implementation practice, the variable transmitting (see 4.3.3) is utilized directly by the PLS Carrier Sense function in recent editions of the standard.

The mapping between variable output_in_~~progress~~process and the variable transmitting is as follows. When output_in_~~progress~~process is true, transmitting is true; when output_in_~~progress~~process is false, transmitting is false.

8. Medium Attachment Unit and baseband medium specifications, type 10BASE5

Change the note the prefaces Clause 8 as follows:

NOTE—This MAU is not recommended for new installations. No maintenance changes will be considered for this clause.

8.1.3.1 Object

Change item c) of 8.1.3.1 as follows:

c) Provide a communication channel capable of high bandwidth and low bit error ~~rate~~ ratio performance. The resultant mean bit error ~~rate~~ ratio, at the physical layer service interface should be less than one part in 10^8 (on the order of one part in 10^9 at the link level).

8.6.1 Transmission system model

Change item c) of 8.6.1 as follows:

c) The repeater unit specified in Clause 9 provides the means for connecting 10 Mb/s baseband segments into a CSMA/CD network. The proper operation of a CSMA/CD network requires network size to be limited to control round-trip propagation delay to meet the requirements of 4.2.3.2.3 and 4.4.2 ~~4.4.2.1~~, and the number of repeaters between any two DTEs to be limited in order to limit the shrinkage of interpacket gap as it travels through the network. Configuration rules, which ensure that these limits are not exceeded, are given in Clause 13.

9. Repeater unit for 10 Mb/s baseband networks

9.1 Overview

Change the third paragraph of 9.1 as follows:

Repeater sets are used to extend the network length and topology beyond what could be achieved by a single mixing segment. Mixing segments may be connected directly by a repeater set (Figure 9–1) or by several repeater units that are, in turn, connected by link segments. Repeater sets are also used as the hub in a star topology network in which DTEs attach directly to link segments (e.g., 10BASE-T, Clause 14). Allowable topologies shall contain only one operative signal path between any two points on the network. The proper operation of a CSMA/CD network requires network size to be limited to control round-trip propagation delay to meet the requirements of 4.2.3.2.3 and <u>4.4.2</u>~~4.4.2.1~~, and the number of repeaters between any two DTEs to be limited in order to limit the shrinkage of interpacket gap as it travels through the network. The method for validating networks with respect to these requirements is specified in Clause 13.

9.9.1.2 Application perspective: FOMAU and medium objectives

Change item c) of 9.9.1.2 as follows:

c) Provide a communication channel capable of high bandwidth and low bit error ~~rate~~ <u>ratio</u> performance. The resultant BER of the FOIRL should be less than one part in 10^{10}.

10. Medium attachment unit and baseband medium specifications, type 10BASE2

10.1.3.1 Object

Change item c) of 10.1.3.1 as follows:

c) Provide a communication channel capable of high bandwidth and low bit error ~~rate~~ ratio performance. The resultant mean bit error ~~rate~~ ratio, at the Physical Layer service interface, should be less than one part in 10^7 (on the order of one part in 10^8 at the link level).

10.7.1 Transmission system model

Change item c) of 10.7.1 as follows:

c) The repeater unit specified in Clause 9 provides the means for connecting 10 Mb/s baseband segments into a CSMA/CD network. The proper operation of a CSMA/CD network requires network size to be limited to control round-trip propagation delay to meet the requirements of 4.2.3.2.3 and 4.4.2~~4.4.2.1~~, and the number of repeaters between any two DTEs to be limited in order to limit the shrinkage of the interpacket gap as it travels through the network. Configuration rules, which ensure that these limits are not exceeded, are given in Clause 13.

11. Broadband medium attachment unit and broadband medium specifications, type 10BROAD36

Change the note that prefaces Clause 11 as follows:

NOTE—This MAU is not recommended for new installations. No maintenance changes will be considered for this clause.

11.1.3 MAU and medium objectives

Change item j) of 11.1.3 as follows:

j) Provide a communication channel capable of high bandwidth and low bit error ~~rate~~ ratio performance. The resultant mean bit error ~~rate~~ ratio at the physical layer service interface should be less than one part in 10^8 (on the order of one part in 10^9 at the link level) in a worst-case signal-to-noise ratio of 26 dB.

11.3.4.8 Bit error rate

Change 11.3.4.8 as follows:

11.3.4.8 Bit error ~~rate~~ ratio

The MAU shall have a Bit Error ~~Rate~~ Ratio (BER) as measured at the AUI lower than one error in 10^8 in a "zero-length coax" test environment (that is, a coaxial cable connection sufficiently short to have negligible delay and transmission impairments). It shall have this BER for receive signal levels in the range specified in 11.3.1.1.3 and in the presence of –28.3 dBmV rms/14 MHz white Gaussian noise. This represents a 24.3 dB signal-to-noise ratio for the specified minimum signal level, –4 dBmV rms. For the same BER in a "system" environment (as opposed to zero-length coax), a 26 dB signal-to-noise ratio is required.

12. Physical signaling, medium attachment, and baseband medium specifications, type 1BASE5

Change the note that prefaces Clause 12 as follows:

NOTE—This MAU is not recommended for new installations. No maintenance changes will be considered for this clause.

12.1.6 Objectives of type 1BASE5 specification

Change item f) of 12.1.6 as follows:

f) Provide a communication channel with a resultant mean bit error ~~rate~~ ratio, at the physical layer service interface, of less than one part in 10^8 (on the order of one part in 10^9 at the link level)

12.2.3.1 Silence

Change 12.2.3.1 as follows:

The <silence> delimiter provides an observation window for an unspecified period of time during which no transitions occur. The minimum duration of <etd> followed by <silence> is the interFrameGap defined in 4.4.2~~4.4.2.2~~.

12.5.3.2.6 Noise immunity

Change 12.5.3.2.6 as follows:

Receivers shall meet the following limits on average error ~~rates~~ ratios when the noise described in 12.7.4 is added to the signals described in 12.5.3.2.1 and 12.5.3.2.2:

a) When nonidle, the receiver error ~~rate~~ ratio shall not exceed one error in 10^8 bits.
b) When idle, a receiver used in a DTE shall not falsely detect carrier more than one in 100 s.
c) When idle, a receiver used in a hub shall not falsely detect carrier more than once in 1500 s.

12.6.1 Line interface connector

Change 12.6.1 as follows:

Eight-pin connectors meeting the requirements of Clause 3 and Figure 1 through Figure 5 of ~~ISO/IEC 8877: 1992~~ IEC 60603-7 shall be used as the compatibility interface between the PMA and the medium. The use of other types of connectors, if any, within a PMA or within the medium, although not explicitly prohibited, is outside the scope of this standard.

12.9.5 Hub timing

Change fifth paragraph of 12.9.5 as follows:

Hub Delay Stretch/Shrink is the increase or decrease in a hub's transit delay due to the effects of differing clock rates. The clock rate tolerance of 0.01% specified in 12.3.2.4.1 and the maximum frame size of 1518 octets specified in 4.4.2~~4.4.2.2~~ yield a maximum stretch or shrink of $(56 + 8 + 1518 \times 8) \times 0.01\% \times 2 < 3$ BT, both at any given hub and through an entire network.

13. System considerations for multisegment 10 Mb/s baseband networks

13.1 Overview

Change the first paragraph of 13.1 as follows:

This clause provides information on building 10 Mb/s multisegment baseband networks within a single collision domain. The proper operation of a CSMA/CD network requires network size to be limited to control round-trip propagation delay to meet the requirements of 4.2.3.2.3 and 4.4.2~~4.4.2.1~~, and the number of repeaters between any two DTEs to be limited in order to limit the shrinkage of the interpacket gap as it travels through the network.

Change the second paragraph of 13.1 as follows:

This clause provides two network models. Transmission System Model 1 is a set of configurations that have been validated under conservative rules and have been qualified as meeting the two requirements set forth above. Transmission System Model 2 is a set of calculation aids that allow a configuration to be qualified against the two requirements. This set of calculation aids allows those configuring a network to test a proposed configuration against a simple set of criteria that allows it to be qualified. The Model 2 Transmission System Model validates an additional broad set of topologies that are fully functional and do not fit within the simpler but more restrictive rules of Model 1. Figure 13–1 illustrates an example of such a topology. The five repeaters are beyond the scope of the Model 1 rules yet this topology is fully functional within the limits of round-trip delay and can be validated as such by Model 2.

13.4.2 Interpacket gap (IPG) shrinkage

Change 13.4.2 as follows:

The worst-case variabilities of transmission elements in the network plus some of the signal reconstruction facilities required in the 10 Mb/s baseband repeater specification combine in such a way that the gap between two packets travelling across the network may be reduced below the interFrameGap specified in 4.4.2~~4.4.2.1~~. This parameter limits the equipment (i.e., number of repeaters) between any two DTEs. Again this limit applies to all combinations of DTEs on any network but the worst case is apparent from an inspection of a map or schematic representation of the topology in question.

Insert new Figure 13–1 into subclause 13.1 as follows. Renumber all existing Clause 13 figures.

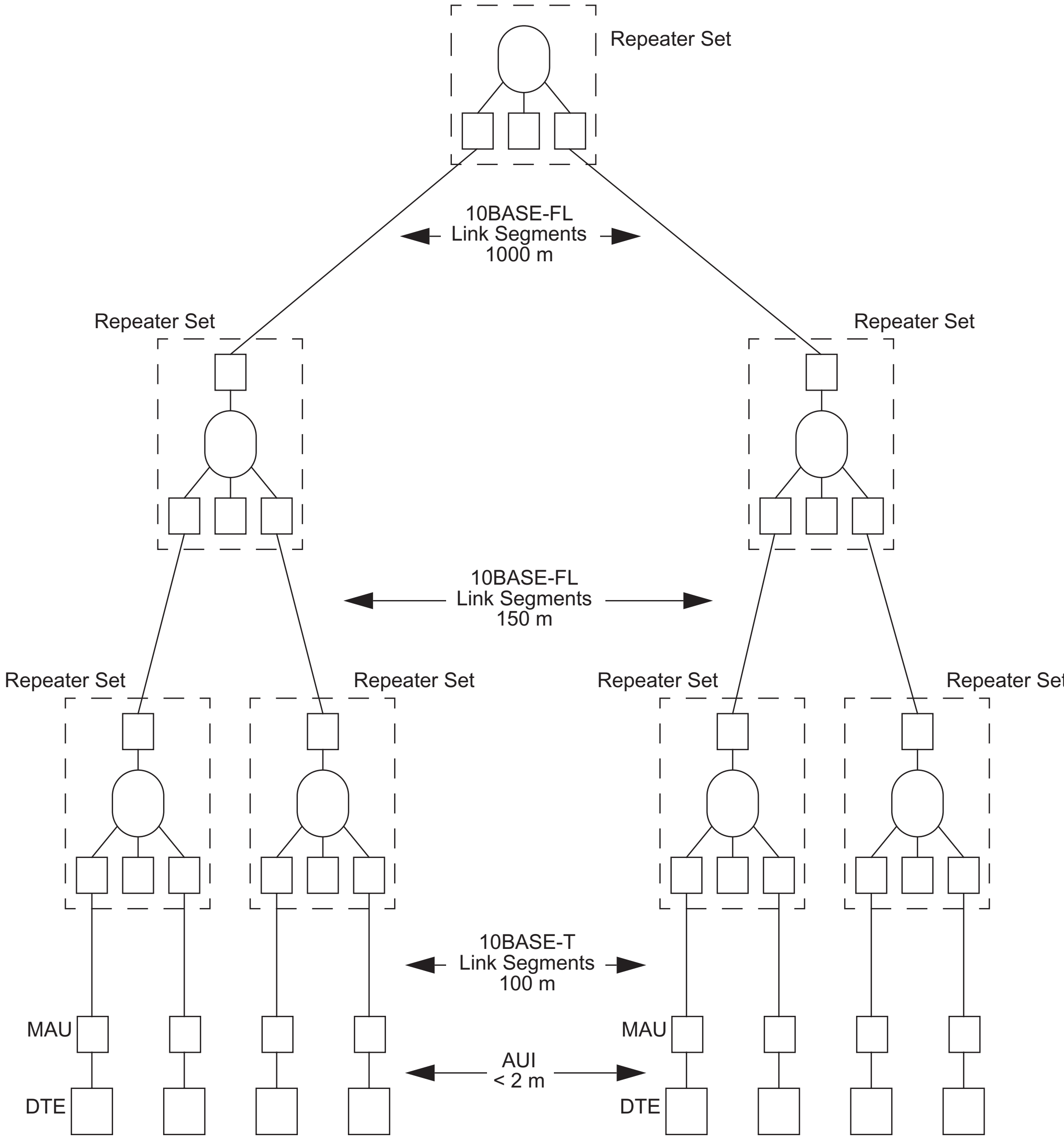


Figure 13–1—Example of maximum transmission path with five repeater sets enabled by Model 2 Transmission System validation

14. Twisted-pair medium attachment unit (MAU) and baseband medium, type 10BASE-T

14.1.3.1 Objectives

Change item c) of 14.1.3.1 as follows:

c) Provide a communication channel with a mean bit error ~~rate~~ ratio, at the physical layer service interface of less than one part in 10^8.

14.4.1 Overview

Change 14.4.1 as follows:

The medium for 10BASE-T is twisted-pair wiring. Since a significant number of 10BASE-T networks are expected to be installed utilizing in-place unshielded telephone wiring and typical telephony installation practices, the end-to-end path including different types of wiring, cable connectors, and cross connects must be considered. Typically, a DTE connects to a wall outlet using a twisted-pair patch cord. Wall outlets connect through building wiring and a cross connect to the repeater MAU in a wiring closet.

NOTE—~~ANSI/TIA/EIA-568-A-1995 [B16] provides specifications for media and installation practices suitable for use with this standard.~~ ISO/IEC 11801:2002 provides a specification for media that exceeds the minimum requirements of this standard.

14.4.4 Noise environment

Change 14.4.4 as follows:

The noise level on the link segments shall be such that the objective error ~~rate~~ ratio is met. The noise environment consists generally of two primary contributors: crosstalk from other 10BASE-T circuits; and externally induced impulse noise, typically from telephone ringing and dialing signals, and other office and building equipment.

14.6 System considerations

Change 14.6 as follows:

The repeater unit specified in Clause 9 forms the central unit for interconnecting 10BASE-T twisted-pair links in networks of more than two nodes. It also provides the means for connecting 10BASE-T twisted-pair links to other 10 Mb/s baseband segments. The proper operation of a CSMA/CD network requires network size to be limited to control round-trip propagation delay to meet the requirements of 4.2.3.2.3 and 4.4.2~~4.4.2.1~~, and the number of repeaters between any two DTEs to be limited in order to limit the shrinkage of the interpacket gap as it travels through the network. Configuration rules, which ensure that these limits are not exceeded, are given in Clause 13.

14.10.4.5.14 MDI requirements

Change 14.10.4.5.14, item 1 as follows:

1	MDI connector	14.5.1	M		~~ISO/IEC 8877: 1992~~ <u>IEC 60603-7</u> jack

14.10.4.7.1 10BASE-T link segment characteristics

Change 14.10.4.7.1, item 15 as follows:

15	Connectors	14.5.1	M		~~ISO/IEC 8877: 1992~~ <u>IEC 60603-7</u> plug

15. Fiber optic medium and common elements of medium attachment units and star, type 10BASE-F

15.1.3.1 Objectives

Change 15.1.3.1 as follows:

c) To provide a communication channel capable of high bandwidth and low bit error ~~rate~~ ratio performance. The resultant mean bit error ~~rate~~ ratio, between AUIs over a fiber segment, should be less than one part in 10^9.

15.2.2 Receive optical parameters

Change 15.2.2 as follows:

The bit error ~~rate~~ ratio(BER) shall be less than one part in 10^9, when measured between two AUIs attached to a single 10BASE-FP, 10BASE-FB, or 10BASE-FL segment for all combinations of valid optical receive parameters specified in the following subclauses and valid optical transmit pulse duty cycle distortion (15.2.1.9). For the case of integrated MAUs, this measurement must be made by inference.

15.3.1.1 Attenuation

Change 15.3.1.1 as follows:

This standard was developed on the basis of an attenuation value of less than or equal to 3.75 dB/km, when measured at a wavelength of 850 nm. Higher loss fiber may be used for shorter fiber pair lengths as long as the requirements in 15.3.3 are met.

NOTE—This value of attenuation is a relaxation of the standard ~~(~~IEC 60793-2: 1992, type A1b, category ≤3.5 dB/km~~)~~, and ISO/IEC 11801:2002~~is the same as ANSI/TIA/EIA-568-A-1995[B16]~~.

15.3.1.2 Modal bandwidth

Change 15.3.1.2 as follows:

Each optical fiber shall have a modal bandwidth-length product of not less than 160 MHz-km at a wavelength of 850 nm.

NOTE—This value of modal bandwidth is a relaxation of the standard IEC 60793-2: 1992, type A1b, category >200 MHz-km~~)~~ and ISO/IEC 11801:2002~~is the same as ANSI/TIA/EIA-568-A-1995 [B16]~~.

15.3.1.3 Chromatic dispersion

Delete 15.3.1.3 and associated un-numbered table. Renumber following subclauses as required.

15.8.6.1 Characteristics of the fiber optic medium

Change 15.8.6.1 as follows:

Item	Feature	Reference	Value/Comment	Status	Support
*M1	Fiber size	15.3.1	62.5/125 µm	O	Yes [ ]No [ ]
M2	Attenuation of fiber	15.3.1.1	≤ 3.75 dB/km at 850 nm when 62.5/125 µm fiber is used	M1: M	N/A [ ]M: Yes [ ]
M3	Fiber modal bandwidth	15.3.1.2	≥160 MHz–km at 850 nm	M	Yes [ ]
~~M4~~	~~Fiber dispersion slope For fiber with a zero dispersion wavelength in the range 1320 nm to 1348 nm~~	~~15.3.1.3~~	~~0.11 ps/nm^2–km~~	~~O/2~~	~~Yes [ ]No [ ]~~
~~M5~~	~~For fiber with a zero dispersion wavelength in the range 1348 nm to 1365 nm~~		~~[1458–l(0)]/1000 ps/nm^2–km~~	~~O/2~~	~~Yes [ ]No [ ]~~
M4~~6~~	Velocity of propagation	15.3.1.~~4~~3	≤ 5 µs/km	M	Yes [ ]

16. Fiber optic passive star and medium attachment unit, type 10BASE-FP

Change the note that prefaces Clause 16 as follows:

NOTE—This MAU is not recommended for new installations. No maintenance changes will be considered for this clause.

19. Layer Management for 10 Mb/s baseband repeaters

19.2.6.1.4 aReadableFrames

Change the behaviour of the attribute aReadableFrames in 19.2.6.1.4 as follows:

BEHAVIOUR DEFINED AS:

A representation of the total frames of valid frame length. Increment counter by one for each frame whose OctetCount is greater than or equal to minFrameSize and less than or equal to maxFrameSize (see 4.4.2~~4.4.2.1~~) and for which the FCSError and CollisionEvent signals are not asserted.

NOTE—This statistic provides one of the parameters necessary for obtaining the packet error rate.

19.2.6.1.6 aFrameCheckSequenceErrors

Change the behaviour of the attribute aFrameCheckSequenceErrors in 19.2.6.1.6 as follows:

BEHAVIOUR DEFINED AS:

Increment counter by one for each frame with the FCSError signal asserted and the FramingError and CollisionEvent signals deasserted and whose OctetCount is greater than or equal to minFrameSize and less than or equal to maxFrameSize (see 4.4.2~~4.4.2.1~~).

19.2.6.1.7 aAlignmentErrors

Change the behaviour of the attribute aAlignmentErrors in 19.2.6.1.7 as follows:

BEHAVIOUR DEFINED AS:

Increment counter by one for each frame with the FCSError and FramingError signals asserted and CollisionEvent signal deasserted and whose OctetCount is greater than or equal to minFrameSize and less than or equal to maxFrameSize (see 4.4.2~~4.4.2.1~~). If aAlignmentErrors is incremented then the aFrameCheckSequenceErrors attribute shall not be incremented for the same frame.

19.2.6.1.8 aFramesTooLong

Change the behaviour of the attribute aFramesTooLong in 19.2.6.1.8 as follows:

BEHAVIOUR DEFINED AS:

Increment counter by one for each frame whose OctetCount is greater than maxFrameSize (see 4.4.24.4.2.1). If aFrameTooLong is counted then neither the aAlignmentErrors nor the aFrameCheckSequenceErrors attribute shall be incremented for the frame.

23. Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 100BASE-T4

Change the note that prefaces Clause 23 as follows:

NOTE—This MAU is not recommended for new installations. No maintenance changes will be considered for this clause.

23.1.2 Objectives

Change item f) of 23.1.2 as follows:

f) To provide a communication channel with a mean ternary symbol error ~~rate~~ ratio, at the PMA service interface, of less than one part in 10^8.

23.1.5.3 Use of 100BASE-T4 PHY for point-to-point communication

Change 23.1.5.3 as follows:

The 100BASE-T4 PHY, in conjunction with the MAC specified in Clauses 1 through 4 (including parameterized values in 4.4.2~~4.4.2.3~~ [Part 1] to support 100 Mb/s operation), may be used at both ends of a link for point-to-point applications between two DTEs. Such a configuration does not require a repeater. In this case each PHY may connect through an MII to its respective DTE. Optionally, either PHY (or both PHYs) may be incorporated into the DTEs without an exposed MII.

23.4.1.3 PMA Receive function

Change the second paragraph of 23.4.1.3 as follows:

The PHY shall receive the signals on the receive pairs (RX_D2, BI_D3, and BI_D4) and translate them into one of the PMA_UNITDATA.indicate parameters IDLE, PREAMBLE, or DATA with a ternary symbol error ~~rate~~ ratio of less than one part in 10^8.

23.6.3 Noise

Change 23.6.3 as follows:

The noise level on the link segments shall be such that the objective error ~~rate~~ ratio is met. The noise environment consists generally of two primary contributors: self-induced near-end crosstalk, which affects the ability to detect collisions, and far-end crosstalk, which affects the signal-to-noise ratio during packet reception.

23.12.4.8 PMA Receive functions

Change 23.12.4.8, item PMR1 as follows:

PMR1	Reception and translation of data with ternary symbol error ~~rate~~ ratio less than	23.4.1.3	M		One part in 10^8

23.12.4.14 Characteristics of the link segment

Change 23.12.4.14, item LNK14 as follows:

LNK14	Noise level	23.6.3	INS:M		Such that objective error ~~rate~~ ratio is met

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

25.4.6.1 Cabling system characteristics

Change the first paragraph of 25.4.6.1 as follows:

The cabling system used to support a 100BASE-TX duplex channel requires two pairs of Category 5 balanced cabling with a nominal impedance of 100 ohms. The cabling system components (cables, cords, and connectors) used to provide the link segment shall consist of Category 5 components as specified in ANSI/TIA/EIA-568-A:1995 and ISO/IEC 11801:1995 (Class D).

NOTE—ISO/IEC 11801:2002 provides a specification (Class D) for media that exceeds the minimum requirements of this standard.

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

26.4.1 Medium Dependent Interface (MDI)

Change 26.4.1 as follows:

The 100BASE-FX medium dependent interface (MDI) shall conform to one of the following connectors. The recommended alternative is the ~~Low Cost Fibre Optical Interface Connector~~ duplex SC connector.

a) ~~Low Cost Fibre Optical Interface Connector (commonly called the duplex SC connector) as specified in ANSI X3.237-1995, 7.1.1 through 7.3.1, inclusive.~~ The duplex SC connector as specified in IEC 61754-4 [B25] and IEC 61754-4, Interface 4-2. (See 38.11.3).

b) Media Interface Connector (MIC) as specified in fiber-PMD 7 and Annex F. When the MIC is used, the receptacle shall be keyed as "M".

c) Optical Medium Connector Plug and Socket (commonly called ST connector) as specified in 15.3.2.

26.5.4 Major capabilities/options

Change 26.5.4 as follows:

Item	Feature	Subclause	Status	Support	Value/Comment
FSC	Supports duplex SC connector ~~Low Cost Fibre Optical Interface Connector (duplex SC)~~	26.4.1	O/1		Recommended. See ~~ANSI X3.237-1995, 7.1.1 through 7.3.1~~ IEC 61754-4 [B25] and IEC 61754-4, Interface 4-2. (See 38.11.3).
*FMC	Supports Media Interface Connector (MIC)	26.4.1	O/1		See ISO/IEC 9314-3: 1990, 7 and 26.4.1
FST	Supports Optical Medium Connector Plug and Socket (ST)	26.4.1	O/1		See 26.4.1

28. Physical Layer link signaling for 10 Mb/s, 100 Mb/s, and 1000 Mb/s Auto-Negotiation on twisted pair

28.1.4 Compatibility considerations

Change the second paragraph of 28.1.4 as follows:

Implementation of the Auto-Negotiation function is optional. For CSMA/CD compatible devices that use the eight-pin modular connector of ~~ISO/IEC 8877: 1992~~ IEC 60603-7 and that also encompass multiple operational modes, if a signaling method is used to automatically configure the preferred mode of operation, then the Auto-Negotiation function shall be used in compliance with Clause 28. If the device uses 10BASE-T compatible link signaling to advertise non-CSMA/CD abilities, the device shall implement the Auto-Negotiation function as administered by this specification. All future CSMA/CD implementations that use an eight-pin modular connector shall be interoperable with devices supporting Clause 28. If the implementor of a non-CSMA/CD eight-pin modular device wishes to assure that its operation does not conflict with CSMA/CD devices, then adherence to Clause 28 is recommended.

28.2.4.1.4 Auto-Negotiation link partner ability register (Register 5) (RO)

Change the second paragraph of 28.2.4.1.4 as follows:

This register contains the Advertised Ability of the Link Partner's PHY. (See Tables 28–3 and 28–4.) The bit definitions shall be a direct representation of the received Link Code Word (Figure 28–7). Upon successful completion of Auto-Negotiation, status register (Register 1) Auto-Negotiation Complete bit (1.5) shall be set to logic one. If the Next Page function is supported~~, the Auto-Negotiation link partner ability register may be used to store Link Partner Next Pages~~ and bit (6.6) in the Auto-Negotiation expansion register (Register 6) is set to logic zero, then the Auto-Negotiation link partner ability register may be used to store Link Partner Next Pages. If bit (6.6) in the Auto-Negotiation expansion register (Register 6) is set to logic one, then bit (6.5) determines where the Link Partner Next Pages are stored.

28.2.4.1.5 Auto-Negotiation expansion register (Register 6) (RO)

Change 28.2.4.1.5 as follows:

All of the bits in the Auto-Negotiation expansion register are read only; a write to the Auto-Negotiation expansion register shall have no effect. (See Table 28–5.)

Bits 6.15:7~~5~~ are reserved for future Auto-Negotiation expansion.

The Receive Next Page Location Able bit (6.6) shall be set to logic one to indicate that the Link Partner Next Page Storage Location bit (6.5) is supported.

The Receive Next Page Storage Location bit (6.5) shall be set to logic one to indicate that the link partner's Next Pages are stored in the Auto-Negotiation Link Partner Received Next Page register (Register 8). This bit shall be set to logic zero to indicate that the link partner's Next Pages are stored in the Auto-Negotiation link partner ability register (Register 5). It is recommended that all new implementations store the link partner's Next Pages in the Auto-Negotiation Link Partner Received Next Page ability register (Register 8).

NOTE— It is highly recommended that the Link Partner Next Page Storage Location bit (6.5) is supported. If this bit is not supported there is no indication if the Link Partners Next Page is stored in register 5 or register 8.

Table 28–5—Expansion register bit definitions

Bit(s)	Name	Description	R/W	Default
6.15:75	Reserved	Write as zero, ignore on read	RO	0
6.6	Receive Next Page Location Able	1 = Received Next Page storage location is specified by bit (6.5) 0 = Received Next Page storage location is not specified by bit (6.5)	RO	—
6.5	Received Next Page Storage Location	1 = Link Partner Next Pages are stored in Register 8 0 = Link Partner Next Pages are stored in Register 5	RO	—
6.4	Parallel Detection Fault	1 = A fault has been detected via the Parallel Detection function 0 = A fault has not been detected via the Parallel Detection function	RO/ LH	0
6.3	Link Partner Next Page Able	1 = Link Partner is Next Page able 0 = Link Partner is not Next Page able	RO	0
6.2	Next Page Able	1 = Local Device is Next Page able 0 = Local Device is not Next Page able	RO	0
6.1	Page Received	1 = A New Page has been received 0 = A New Page has not been received	RO/ LH	0
6.0	Link Partner Auto-Negotiation Able	1 = Link Partner is Auto-Negotiation able 0 = Link Partner is not Auto-Negotiation able	RO	0

The Parallel Detection Fault bit (6.4) shall be set to logic one to indicate that zero or more than one of the NLP Receive Link Integrity Test function, 100BASE-TX, or 100BASE-T4 PMAs have indicated link_status=READY when the autoneg_wait_timer expires. The Parallel Detection Fault bit shall be reset to logic zero on a read of the Auto-Negotiation expansion register (Register 6).

The Link Partner Next Page Able bit (6.3) shall be set to logic one to indicate that the Link Partner supports the Next Page function. This bit shall be reset to logic zero to indicate that the Link Partner does not support the Next Page function.

The Next Page Able bit (6.2) shall be set to logic one to indicate that the Local Device supports the Next Page function. The Next Page Able bit (6.2) shall be set to logic zero if the Next Page function is not supported.

The Page Received bit (6.1) shall be set to logic one to indicate that a new Link Code Word has been received and stored in the Auto-Negotiation link partner ability register. The Page Received bit shall be reset to logic zero on a read of the Auto-Negotiation expansion register (Register 6).

The Link Partner Auto-Negotiation Able bit (6.0) shall be set to logic one to indicate that the Link Partner is able to participate in the Auto-Negotiation function. This bit shall be reset to logic zero if the Link Partner is not Auto-Negotiation able.

28.2.4.1.6 State diagram variable to MII register mapping

Change 28.2.4.1.6 as follows:

The state diagrams of Figure 28–14 through Figure 28–17 generate and accept variables of the form “mr_x,” where x is an individual signal name. These variables comprise a management interface that may be connected to the MII management function or other equivalent function. Table 28–6 describes how the MII registers map to the management function interface signals.

Table 28–6 — State diagram variable to MII register mapping

State diagram variable	MII register
mr_adv_ability[16:1]	4.15:0 Auto-Negotiation advertisement register
mr_autoneg_complete	1.5 Auto-Negotiation Complete
mr_autoneg_enable	0.12 Auto-Negotiation Enable
mr_lp_adv_ability[16:1]	<u>For Base Page:</u> 5.15:0 Auto-Negotiation link partner ability register <u>For Next Page(s):</u> <u>If 6.6=1 and 6.5=1 then 8.15:0 is Auto-Negotiation Link Partner Received Next Page register</u> <u>If 6.6=1 and 6.5= 0 then 5.15:0 is Auto-Negotiation link partner ability register</u> <u>If 6.6=0 then 8.15:0 or 5.15:0 is Auto-Negotiation link partner Next Page ability register</u>
mr_lp_autoneg_able	6.0 Link Partner Auto-Negotiation Able
mr_lp_np_able	6.3 Link Partner Next Page Able
mr_main_reset	0.15 Reset
mr_next_page_loaded	Set on write to Auto-Negotiation Next Page Transmit register; cleared by Arbitration state diagram
mr_np_able	6.2 Next Page Able
mr_np_tx[16:1]	7.15:0 Auto-Negotiation Next Page Transmit Register
mr_page_rx	6.1 Page Received
mr_parallel_detection_fault	6.4 Parallel Detection Fault
mr_restart_negotiation	0.9 Auto-Negotiation Restart
set if Auto-Negotiation is available	1.3 Auto-Negotiation Ability

28.2.4.1.7 Auto-Negotiation Link Partner Received Next Page ~~Ability~~ register (Register 8) (RO)

Change 28.2.4.1.7 as follows:

Support for 100BASE-T2 and 1000BASE-T requires support for Next Page and the provision of an Auto-Negotiation Link Partner Received Next Page ~~Ability~~ register (register 8) to store Link Partner Next Pages as shown in Table 28–7. All of the bits in the Auto-Negotiation Link Partner Received Next Page ~~Ability~~ register are read only. A write to the Auto-Negotiation Link Partner Received Next Page ~~Ability~~ register shall have no effect.

The values contained in this register are only guaranteed to be valid after the Page Received bit (6.1) has been set to logical one or once Auto-Negotiation has successfully completed, as indicated by bit 1.5.

NOTE—If this register is used to store multiple Link Partner Next Pages, the previous value of this register is assumed to be stored by a management entity that needs the information overwritten by subsequent Link Partner Next Pages.

Table 28–7—Link Partner Received Next Page ~~Ability~~ register bit definitions

Bit(s)	Name	Description	R/W
8.15	Next Page	see 28.2.3.4	RO
8.14	Acknowledge	see 28.2.3.4	RO
8.13	Message Page	see 28.2.3.4	RO
8.12	Acknowledge 2	see 28.2.3.4	RO
8.11	Toggle	see 28.2.3.4	RO
8.10:0	Message/Unformatted Code Field	see 28.2.3.4	RO

28.5.3 Major capabilities/options

Insert the following item at the end of 28.5.3:

Item	Feature	Subclause	Status	Support	Value/comment
*NPSL	Link Partner Next Page Storage Location bit	28.2.4.1.5	O		N/A

28.5.4.6 Management function requirements

Insert the following two new items between items 21 and 22 in subclause 28.5.4.6:

Item	Feature	Subclause	Status	Support	Value/comment
21a	Link Partner Next Page Storage Location bit	28.2.4.1.5	NPSL * MII:M		Indicates location of Link Partner Next Page
21b	Receive Next Page Location Able bit	28.2.4.1.5	MII:M		Indicates if Link Partner Next Page Storage Location bit is supported.

29. System considerations for multisegment 100BASE-T networks

29.1.1 Single collision domain multisegment networks

Change first paragraph of 29.1.1 as follows:

This clause provides information on building 100 Mb/s CSMA/CD multisegment networks within a single collision domain. The proper operation of a CSMA/CD network requires the physical size and number of repeaters to be limited in order to meet the round-trip propagation delay requirements of 4.2.3.2.3 and 4.4.24.4.2.1 and IPG requirements specified in 4.4.24.4.2.1.

30. 10 Mb/s, 100 Mb/s, 1000 Mb/s, and 10 Gb/s Management

30.5.1.1.4 aMediaAvailable

Change 30.5.1.1.4 (modified by IEEE Std 802.3ae-2002), APPROPRIATE SYNTAX as follows:

APPROPRIATE SYNTAX:

An ENUMERATED value list that has the following entries:

other	undefined
unknown	initializing, true state not yet known
available	link or light normal, loopback normal
not available	link loss or low light, no loopback
remote fault	remote fault with no detail
invalid signal	invalid signal, applies only to 10BASE-FB
remote jabber	remote fault, reason known to be jabber
remote link loss	remote fault, reason known to be far-end link loss
remote test	remote fault, reason known to be test
offline	offline, applies only to Clause 37 [Part 3] Auto-Negotiation
auto neg error	Auto-Negotiation Error, applies only to Clause 37 [Part 3] Auto-Negotiation
PMD link fault	PMD/PMA receive link fault
WIS frame loss	WIS loss of frame, applies only to 10GBASE-W
WIS signal loss	WIS loss of signal, applies only to 10GBASE-W
PCS link fault	PCS receive link fault
excessive BER	PCS Bit Error ~~Rate~~ Ratio monitor reporting excessive error ~~rate~~ ratio
DXS link fault	DTE XGXS receive link fault, applies only to XAUI
PXS link fault	PHY XGXS transmit link fault, applies only to XAUI

30.8.1.1.3 aLineSESThreshold

Change 30.8.1.1.3 (inserted by IEEE Std 802.3ae-2002), NOTE as follows:

NOTE—8554 is selected to reflect the number of Section BIP-8 Errors that would occur with a random bit error ~~rate~~ ratio of 1×10^{-6} (see Annex 50A).;

30.8.1.1.11 aLineSESThreshold

Change 30.8.1.1.11 (inserted by IEEE Std 802.3ae-2002), NOTE as follows:

NOTE—9835 is selected to reflect the number of Line BIP Errors that would occur with a random bit error ~~rate~~ ratio of 1×10^{-6} (see Annex 50A).;

31. MAC Control

31.5.3 Opcode-independent MAC Control receive state diagram

Change 31.5.3 and its subclauses as follows:

The MAC Control sublayer shall implement the receive state machine specified in this subclause.

31.5.3.1 Constants

802.3_MAC_Control
: The 16-bit Length/Type field value reserved for CSMA/CD MAC Control usage, specified in 31.4.1.3.

31.5.3.2 Variables

receiveEnabled
: A boolean set by Network Management to indicate that the station is permitted to receive from the network.

Values: true; Receiver is enabled by management
false; Receiver is disabled by management

DA
: The destination address field parsed from the received frame.

SA
: The source address field parsed from the received frame.

lengthOrType
: The lengthOrType field parsed from the received frame.

data
: The data payload field parsed from the received frame.

fcs
: The fcs field parsed from the received frame.

fcsPresent
: A boolean set by the MAC sublayer. See 4.3.2.

ReceiveStatus
: Indicates the status of the received frame. See 4.3.2.

opcode
: The MAC Control opcode field parsed from the received frame.

31.5.3.3 Functions

ReceiveFrame
: The MAC ~~S~~sublayer ~~primitive called to receive a frame with the specified parameters~~function invoked to accept an incoming frame with the specified parameters. See 4.2.9 and 4.3.2.

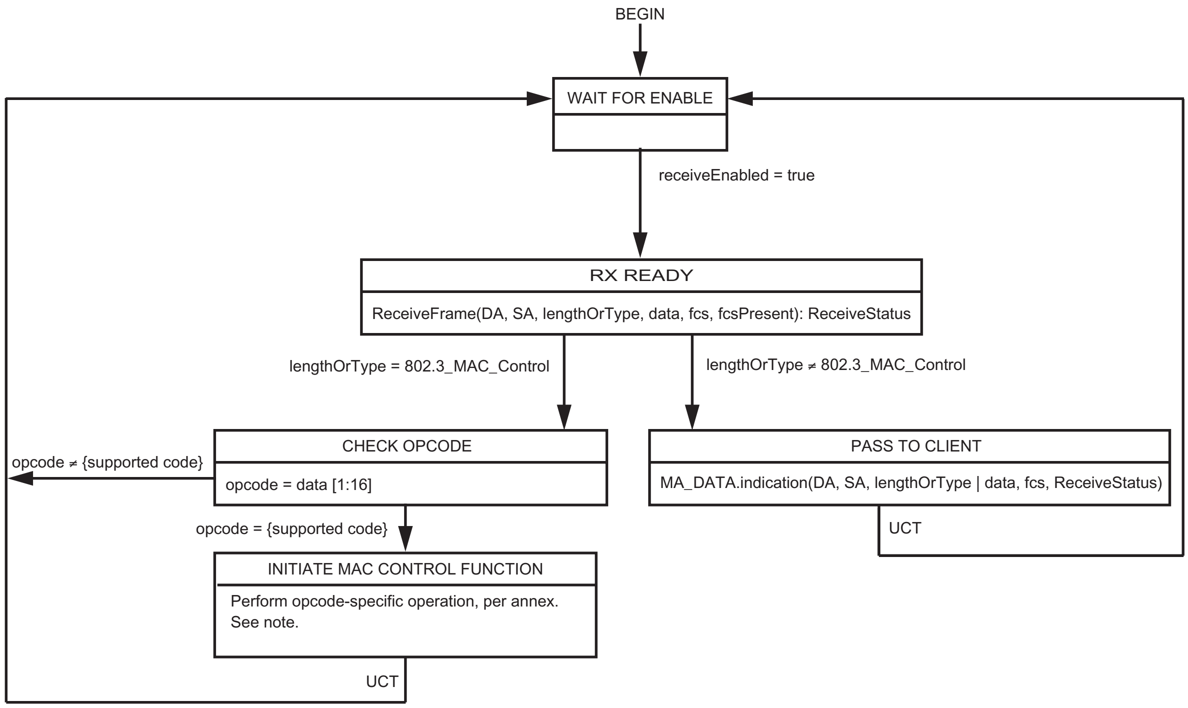
31.5.3.4 Messages

~~MA_CONTROL.indication~~
: ~~A signal sent by the MAC Control sublayer signifying a change in the internal sublayer state.~~

MA_DATA.indication

The service primitive used ~~by the MAC Control sublayer to pass a received data frame to the~~ to transfer an incoming frame to the MAC Control client with the specified parameters. See 2.3.2.

Replace Figure 31–4 with the following:



NOTE—The opcode-specific operation is launched as a parallel process by the MAC Control sublayer, and not as a synchronous function. Progress of the generic MAC Control Receive state machine (as shown in this figure) is not implicitly impeded by the launching of the opcode-specific function.

Figure 31–4—Generic MAC Control Receive state diagram

32. Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 100BASE-T2

Change the note that prefaces Clause 32 as follows:

NOTE—This MAU is not recommended for new installations. No maintenance changes will be considered for this clause.

32.1 Overview

Change item h) of 32.1 as follows:

h) To provide a communication channel with a symbol error ~~rate~~ ratio of less than one part in 10^{10} at the PMA service interface.

32.1.3.3 Use of 100BASE-T2 PHY for point-to-point communication

Change 32.1.3.3 as follows:

The 100BASE-T2 PHY, in conjunction with the MAC specified in Clause 1 through Clause 4 (including parameterized values in 4.4.2~~4.4.2.3~~ to support 100 Mb/s operation) may be used at both ends of a link for point-to-point applications between two DTEs. Such a configuration does not require a repeater. In this case each PHY may connect through an MII to its respective DTE. Optionally, either PHY (or both PHYs) may be incorporated into the DTEs without an exposed MII.

32.4.1.1.3 PMA Receive function

Change the first paragraph of 32.4.1.1.3 as follows:

The PMA Receive function comprises two independent receivers for quinary pulse-amplitude modulated signals on each of the two pairs BI_DA and BI_DB. PMA Receive contains the circuits necessary to detect quinary symbol sequences from the signals received at the MDI over receive pairs BI_DA and BI_DB and present these sequences to the PCS Receive function. The signals received at the MDI are described mathematically in 32.4.1.2.2. The PHY shall translate the signals received on pairs BI_DA and BI_DB into the PMA_UNITDATA.indicate parameter rx_symb_vector with a symbol error ~~rate~~ ratio of less than one part in 10^{10}.

32.4.1.1.5 Clock Recovery function

Change the second paragraph of 32.4.1.1.5 as follows:

The Clock Recovery function shall provide a clock suitable for synchronous signal sampling on each line so that the symbol-error ~~rate~~ ratio indicated in 32.4.1.1.3 is achieved. The received clock signal must be stable and ready for use when training has been completed (loc_rcvr_status=OK).

32.6.1.3.3 Receiver differential input signals

Change the first paragraph of 32.6.1.3.3 as follows:

Differential signals received on the receive inputs that were transmitted within the specifications given in 32.6.1.2, and have then passed through a link as defined in 32.7, shall be translated into one of the PMA_UNITDATA.indicate messages with an symbol error ~~rate~~ ratio less than 10^{-10} and sent to the PCS after link bring-up.

32.6.1.3.4 Receiver Alien NEXT tolerance

Change the first paragraph of 32.6.1.3.4 as follows:

Differential signals received from the test channel defined in 32.6.1.3.1 shall be detected with a symbol error ~~rate~~ ratio less than 10^{-8} when the PHY is in receiver test mode for the following combinations of channel and worst-case alien NEXT responses, as shown in Table 32-13.

32.7.2.3.1 Differential near-end crosstalk (NEXT) loss

Change 32.7.2.3.1 as follows:

The differential Near-End Crosstalk (NEXT) loss between the two duplex channels of a link segment is specified in order to limit the crosstalk noise at the near end of a link segment to meet the symbol error ~~rate~~ ratio objective specified in 32.1 and the noise specifications of 32.7.3. The NEXT loss between the two duplex channels of a link segment shall be at least $19.3 - 16.6\log_{10}(f/16)$ (where f is the frequency in MHz) over the frequency range 2–16 MHz.

32.7.2.3.3 Equal level far-end crosstalk loss (ELFEXT)

Change the first paragraph of 32.7.2.3.3 as follows:

Equal Level Far-End Crosstalk (ELFEXT) loss is specified in order to limit the crosstalk noise at the far end of a link segment to meet the symbol error ~~rate~~ ratio objective specified in 32.1 and the noise specifications of 32.7.3. Far-End Crosstalk (FEXT) noise is the crosstalk noise that appears at the far end of one of the duplex channels which is coupled from one of the duplex channels with the noise source (transmitters) at the near end. ELFEXT loss is the ratio of the data signal to FEXT noise at the far end output of a duplex channel. To limit the FEXT noise from an adjacent duplex channel, the ELFEXT loss between each duplex channel shall be greater than $20.9 - 20\log_{10}(f/16)$ dB (where f is the frequency in MHz) over the frequency range 2–16 MHz. ELFEXT loss at frequency f and distance l is defined as

32.13.5.4 PMA functions

Change 32.13.5.4, item PMF6 as follows:

PMF6	PMA Receive function shall translate	32.4.1.1.3	M	Yes [ ]	~~Translate t~~The signals received on pairs BI_DA and BI_DB into the PMA_UNITDATA.indicate parameter rx_symb_vector with a symbol error ~~rate~~ ratio of less than one part in 10^{10}.

Change 32.13.5.4, item PMF8 as follows:

PMF8	Clock Recovery function shall provide	32.4.1.1.5	M	Yes [ ]	A clock suitable for synchronous signal sampling on each line so that the symbol-error ~~rate~~ ratio indicated in 32.4.1.1.3 is achieved.

32.13.5.8 PMA electrical specifications

Change 32.13.5.8, item PME49 as follows:

PME49	Differential signals received on the receive inputs that were transmitted within the constraints of 32.6.1.2, and have then passed through a link as defined in 32.7, shall be translated into	32.6.1.3.3	M	Yes [ ]	One of the PMA_UNITDATA.indicate messages with an bit error ~~rate~~ ratio less than 10^{-10} and sent to the PCS after link bring-up.

Change 32.13.5.8, item PME51 as follows:

PME51	Differential signals received from the test channel defined in 32.6.1.3.1 shall be detected	32.6.1.3.4	M	Yes [ ]	With a symbol error ~~rate~~ ratio less than 10^{-10} when the PHY is in receiver test mode for the combinations of channel and worst-case alien NEXT responses specified in 32.6.1.2.

32.13.5.9 Characteristics of the link segment

Change 32.13.5.9, item LKS 17 as follows:

LKS17	The noise level on the link segments shall be such that	32.7.3	M	Yes [ ]	The objective error ~~rate~~ ratio is met.

35. Reconciliation Sublayer (RS) and Gigabit Media Independent Interface (GMII)

35.2.2.2 RX_CLK (receive clock)

Change 35.2.2.2 as follows:

RX_CLK is a continuous clock that provides the timing reference for the transfer of the RX_DV, RX_ER and RXD signals from the PHY to the Reconciliation sublayer. RX_DV, RX_ER and RXD are sampled by the Reconciliation sublayer on the rising edge of RX_CLK. RX_CLK is sourced by the PHY.

~~The PHY may recover the RX_CLK~~ The frequency of RX_CLK may be derived from the received data or it may be that of a nominal ~~derive the RX_CLK reference from a local~~ clock (e.g., GTX_CLK). ~~When derived from the received data, RX_CLK shall have a frequency equal to one-eighth of the data rate of the received signal, and when derived from a local clock a nominal frequency of 125 MHz.~~ When the received data rate at the PHY is within tolerance, the RX_CLK frequency shall be 125MHz ±0.01%, one-eighth of the MAC receive data rate.

~~When the signal received from the medium is continuous and the PHY can recover the RX_CLK reference and supply the RX_CLK on a continuous basis, there~~ There is no need to transition between the recovered clock reference and a nominal ~~local~~ clock reference on a frame-by-frame basis. If loss of received signal from the medium causes a PHY to lose the recovered RX_CLK reference, the PHY shall source the RX_CLK from a ~~local~~ nominal clock reference. Transitions from nominal clock to recovered clock or from recovered clock to nominal clock shall not decrease the period, or time between adjacent edges, of RX_CLK below the limits specified in Table 35–8, and shall not increase the time between adjacent edges of RX_CLK more than twice the nominal clock period.

Transitions from local clock to recovered clock or from recovered clock to local clock shall be made only while RX_DV and RX_ER are de-asserted. During the interval between the assertion of CRS and the assertion of RX_DV at the beginning of a frame, the PHY may extend a cycle of RX_CLK by holding it in either the high or low condition until the PHY has successfully locked onto the recovered clock. Following the de-assertion of RX_DV at the end of a frame, or the de-assertion of RX_ER at the end of carrier extension, the PHY may extend a cycle of RX_CLK by holding it in either the high or low condition for an interval that shall not exceed twice the nominal clock period.

NOTE—This standard neither requires nor assumes a guaranteed phase relationship between the RX_CLK and GTX_CLK signals. See additional information in 35.4.

35.5.3.2 GMII signal functional specifications

Change 35.5.3.2 items SF1 through SF5 as follows:

SF1					
SF2	RX_CLK frequency	35.2.2.2	125 MHz ±0.01% when received data rate is within tolerance.One eighth of received data rate or nominal 125 MHz.	M	Yes [ ]
SF3	RX_CLK source on loss Loss of signal	35.2.2.2	Source RX_CLK from nominal clock.Nominal clock reference (e.g., GTX_CLK)	M	Yes [ ]
SF4	RX_CLK min high/low time during transitions between recovered and nominal clock sources	35.2.2.2	No decrease of period, or time between adjacent edges, of RX_CLK below limits specified in Table 35-8.While RX_DV de-asserted	M	Yes [ ]
SF5	RX_CLK max high/low time following de-assertion of RX_DVduring transitions between clock sources	35.2.2.2	No increase greater than two Maximum 2 times the nominal clock periods between adjacent edges of RX_CLK	M	Yes [ ]

36. Physical Coding Sublayer (PCS) and Physical Medium Attachment (PMA) sublayer, type 1000BASE-X

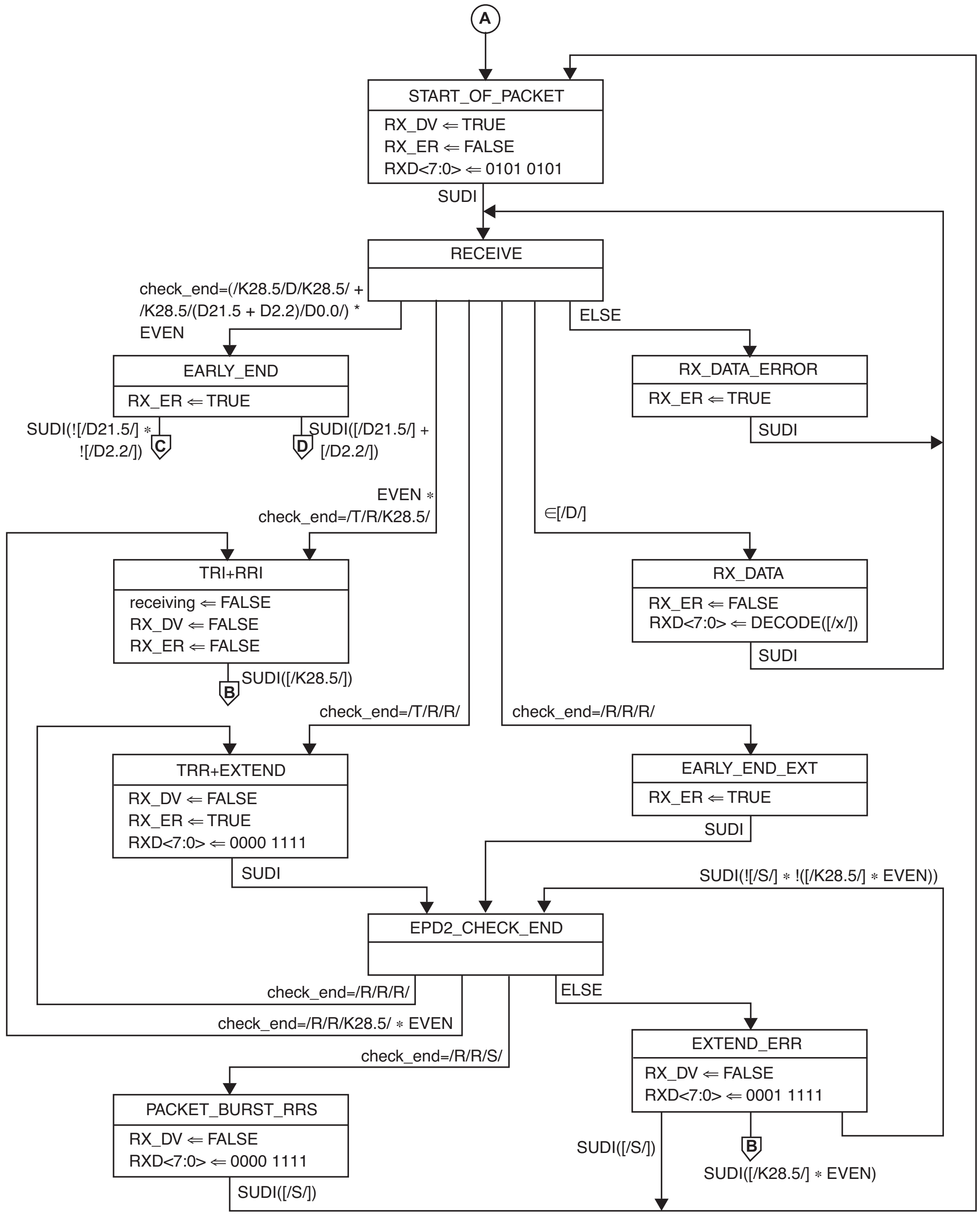
36.2.4.6 Checking the validity of received code-groups

Change the last paragraph of 36.2.4.6 as follows:

The number of invalid code-groups detected is proportional to the bit-error-~~rate~~ratio (BER) of the link. Link error monitoring may be performed by counting invalid code-groups.

36.2.5.2.2 Receive

Change notes of Figure 36–7b as follows:



NOTE 1—Outgoing arcs leading to labeled polygons flow offpage to corresponding incoming arcs leading from labeled circles on Figure 36–7a, and vice versa.
NOTE 2—In the transition from RECEIVE to RX_DATA state the transition condition is a test against the code-group obtained from the SUDI that caused the transition to RECEIVE state.

Figure 36–7b—PCS receive state diagram, part b

40. Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 1000BASE-T

40.1 Overview

Change the first paragraph of 40.1 as follows:

The 1000BASE-T PHY is one of the Gigabit Ethernet family of high-speed CSMA/CD network specifications. The 1000BASE-T Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) and baseband medium specifications are intended for users who want 1000 Mb/s performance over Category 5 balanced twisted-pair cabling systems. 1000BASE-T signaling requires four pairs of ~~Category 5~~ balanced cabling, as specified in ISO/IEC 11801:1995 (Class D) and ANSI/EIA/TIA-568-A- ~~(1995)~~ (Category 5), and tested for the additional performance parameters specified in ANSI/EIA/TIA-568-B1 Annex D~~40.7 using testing procedures defined in proposed ANSI/TIA/EIA TSB95~~.

NOTE—ISO/IEC 11801:2002 provides a specification (Class D) for media that exceeds the minimum requirements of this standard.

40.1.1 Objectives

Change item g) of 40.1.1 as follows:

h) Bit Error ~~Rate~~ Ratio of less than or equal to 10^{-10}

40.3.3.1 Variables

Change the first two definitions of 40.3.3.1 as follows:

CEXT
: ~~A vector~~ A sequence of vectors of four quinary symbols corresponding to the code-group generated in idle mode to denote carrier extension, as specified in 40.3.1.3.

CEXT_Err
: ~~A vector~~ A sequence of vectors of four quinary symbols corresponding to the code-group generated in idle mode to denote carrier extension with error indication, as specified in 40.3.1.3.

40.4.2.3 PMA Receive function

Change the first paragraph of 40.4.2.3 as follows:

The PMA Receive function comprises four independent receivers for quinary pulse-amplitude modulated signals on each of the four pairs BI_DA, BI_DB, BI_DC, and BI_DD. PMA Receive contains the circuits necessary to both detect quinary symbol sequences from the signals received at the MDI over receive pairs BI_DA, BI_DB, BI_DC, and BI_DD and to present these sequences to the PCS Receive function. The signals received at the MDI are described mathematically in 40.4.3.2. The PMA shall translate the signals received on pairs BI_DA, BI_DB, BI_DC, and BI_DB into the PMA_UNITDATA.indicate parameter rx_symb_vector with a symbol error ~~rate~~ ratio of less than 10^{-10} over a channel meeting the requirements of 40.7.

40.4.2.6 Clock Recovery function

Change the second paragraph of 40.4.2.6 as follows:

The Clock Recovery function shall provide clocks suitable for signal sampling on each line so that the symbol-error ~~rate~~ ratio indicated in 40.4.2.3 is achieved. The received clock signal must be stable and ready for use when training has been completed (loc_rcvr_status=OK). The received clock signal is supplied to the PMA Transmit function by received_clock.

40.4.5.1 State diagram variables

Change the description of the variable Link_Det in 40.4.5.1 as follows:

Link_Det

This variable indicates linkpulse = true or link_status = READY or OK has occurred at the receiver since the last time sample_timer has been started.

Values: TRUE: linkpulse = true or link_status = READY or OK has occurred since the last time sample_timer has been started.

FALSE: otherwise

40.6.1.1.1 Test channel

Change the first paragraph of 40.6.1.1.1 as follows:

To perform the transmitter MASTER-SLAVE timing jitter tests described in this clause, a test channel is required to ensure that jitter is measured under conditions of poor signal to echo ratio. This test channel shall be constructed by combining 100 and 120 Ω cable segments that both meet or exceed ISO/IEC 11801 Category 5 specifications for each pair, as shown in Figure 40–18, with the lengths and additional restrictions on parameters described in Table 40–6. The ends of the test channel shall be terminated with connectors meeting or exceeding ~~ANSI/TIA/EIA-568-A:1995 or~~ ISO/IEC 11801:1995 Category 5 specifications. The return loss of the resulting test channel shall meet the return loss requirements of 40.7.2.3 and the crosstalk requirements of 40.7.3.

40.6.1.3.1 Receiver differential input signals

Change 40.6.1.3.1 as follows:

Differential signals received at the MDI that were transmitted from a remote transmitter within the specifications of 40.6.1.2 and have passed through a link specified in 40.7 are translated into one of the PMA_UNITDATA.indicate messages with a 4-D symbol error ~~rate~~ ratio less than 10^{-10} and sent to the PCS after link reset completion. Since the 4-D symbols are not accessible, this specification shall be satisfied by a frame error ~~rate~~ ratio less than 10^{-7} for 125 octet frames.

40.6.1.3.4 Alien Crosstalk noise rejection

Change the first paragraph of 40.6.1.3.4 as follows:

While receiving data from a transmitter specified in 40.6.1.2 through a link segment specified in 40.7 connected to all MDI duplex channels, a receiver shall send the proper PMA_UNITDATA.indicate message to the PCS when any one of the four pairs is connected to a noise source as described in Figure 40–28. Because symbol encoding is employed, this specification shall be satisfied by a frame error ~~rate~~ ratio of less than 10^{-7} for 125 octet frames. The level of the noise signal at the MDI is nominally 25 mV peak-to-peak. (Measurements are to be made on each of the four pairs.) The noise source shall be connected to one of the MDI inputs using Category 5 balanced cable of a maximum length of 0.5 m.

40.7 Link segment characteristics

Change subclauses 40.7 through 40.7.2.1 as follows:

1000BASE-T is designed to operate over a 4-pair Category 5/Class D balanced cabling system. Each of the four pairs supports an effective data rate of 250 Mbps in each direction simultaneously. The term "link segment" used in this clause refers to four duplex channels. The term "duplex channel" will be used to refer to a single channel with full duplex capability. Specifications for a link segment apply equally to each of the four duplex channels. All implementations of the balanced cabling link shall be compatible at the MDI.

40.7.1 Cabling system characteristics

1000BASE-T requires 4-pair Class D cabling with a nominal impedance of 100 Ω, as specified in ISO/IEC 11801:1995~~The cabling system used to support 1000BASE-T requires 4 pairs of Category 5 balanced cabling with a nominal impedance of 100 Ω~~. The cabling system components (cables, cords, and connectors) used to provide the link segment shall consist of Category 5 components as specified in ANSI/TIA/EIA-568-A:1995 and ISO/IEC 11801:1995. Additionally:

~~a) 1000BASE-T uses a star topology with Category 5 balanced cabling used to connect PHY entities.~~
a) 1000BASE-T is an ISO/IEC 11801:1995 Class D application, with additional installation requirements and transmission parameters specified in Annex 40A.
b) The width of the PMD transmit signal spectrum is approximately 80 MHz.
c) The use of shielding is outside the scope of this standard.

40.7.2 Link transmission parameters

The transmission parameters contained in this subclause are specified to ensure that a Class D~~Category 5~~ link segment of up to at least 100 m will provide a reliable medium. The transmission parameters of the link segment include insertion loss, delay parameters, characteristic impedance, NEXT loss, ELFEXT loss, and return loss.

Link segment testing shall be conducted using source and load impedances of 100 Ω. The tolerance on the poles of the test filter used in this subclause shall be no worse than 1%.

40.7.2.1 Insertion loss

The insertion loss of each duplex channel shall be less than

$$\text{Insertion\_Loss}(f) < 2.1\, f^{0.529} + 0.4/f \qquad \text{(dB)}$$

at all frequencies from 1 MHz to 100 MHz. This includes the attenuation of the balanced cabling pairs, including work area and equipment cables plus connector losses within each duplex channel. The insertion loss specification shall be met when the duplex channel is terminated in 100 Ω.

NOTE—The above equation approximates the insertion loss specification at discrete frequencies for Class D 100 m channels specified by ISO/IEC 11801:1995~~Category 5 100-meter links specified in ANSI/TIA/EIA-568-A Annex E and in TIA/EIA TSB-67~~.

40.7.3.1.1 Differential Near-End Crosstalk

Change 40.7.3.1.1 as follows:

In order to limit the crosstalk at the near end of a link segment, the differential pair-to-pair Near-End Crosstalk (NEXT) loss between a duplex channel and the other three duplex channels is specified to meet the symbol error ~~rate~~ ratio objective specified in 40.1. The NEXT loss between any two duplex channels of a link segment shall be at least

$$27.1 - 16.8\log_{10}(f/100)$$

where f is the frequency over the range of 1 MHz to 100 MHz.

NOTE—The above equation approximates the NEXT loss specification at discrete frequencies for Class D 100 m channels specified by ISO/IEC 11801:1995 ~~Category 5 100-meter links specified in ANSI/TIA/EIA-568-A Annex E and in TSB-67~~.

40.7.5 Noise environment

Change item g) of 40.7.5 as follows:

g) Noise from signals in adjacent cables. This noise is referred to as alien NEXT noise and is generally present when cables are bound tightly together. Since the transmitted symbols from the alien NEXT noise source are not available to the cancellation processor (they are in another cable), it is not possible to cancel the alien NEXT noise. To ensure robust operation the alien NEXT noise must meet the specification of ~~40.7.5.1~~ 40.7.6.

40.8.3 MDI electrical specifications

Change the first paragraph of 40.8.3 as follows:

The MDI connector (jack) when mated with a specified balanced cabling connector (plug) shall meet the electrical requirements for Category 5 connecting hardware for use with 100-ohm Category 5 cable as specified in ~~ANSI/TIA/EIA-568-A:1995 and~~ ISO/IEC 11801:1995.

40.12.5 Physical Medium Attachment (PMA)

Change 40.12.5, item PMF8 as follows:

PMF8	PMA Receive function shall translate	40.4.2.3	M	Yes [ ]	~~Translate t~~The signals received on pairs BI_DA BI_DB, BI_DC and BI_DD into the PMA_UNITDATA.indicate parameter rx_symb_vector with a symbol error ~~rate~~ ratio of less than one part in 10^{10}.

Change 40.12.5, item PMF11 as follows:

PMF11	Clock Recovery function shall provide	40.4.2.6	M	Yes [ ]	~~Provide c~~Clocks suitable for signal sampling on each line so that the symbol-error ~~rate~~ ratio indicated in 40.4.2.3 is achieved.

40.12.7 PMA Electrical Specifications

Change 40.12.7, item PME20 as follows:

PME20	The ends of the MASTER-SLAVE timing jitter test channel shall	40.6.1.1.1	M	Yes [ ]	Be connectorized with connectors meeting or exceeding ~~ANSI/TIA/EIA-568-A:1995 or~~ ISO/IEC 11801:1995 Category 5 specifications.

Change 40.12.7, item PME64 as follows:

PME64	Differential signals received on the receive inputs that were transmitted within the specifications given in 40.6.1.2 and have then passed through a link compatible with 40.7, shall be translated into	40.6.1.3.1	M	Yes [ ]	One of the PMA_UNITDATA.indicate messages with a 4-D symbol rate error less than 10^{-10} and sent to the PCS after link bring-up. Since the 4-D symbols are not accessible, this specification shall be satisfied by a frame error ~~rate~~ ratio less than 10^{-7} for 125 octet frames.

Change 40.12.7, item PME69 as follows:

PME69	The alien crosstalk test specified in 40.6.1.3.4 shall be satisfied by	40.6.1.3.4	M	Yes [ ]	A frame error ~~rate~~ ratio of less than 10^{-7} for 125 octet frames

40.12.8 Characteristics of the link segment

Change 40.12.8, item LKS2 as follows:

LKS2	1000BASE-T links shall be compliant	40.7.1	M	Yes [ ]	With Class D performance requirements,~~Consist of Category 5 components~~ as specified ~~in ANSI/TIA/EIA-568-A:1995 and~~ by ISO/IEC 11801:1995.

40.12.9 MDI requirements

Change 40.12.9, item MDI5 as follows:

MDI5	The MDI connector (jack) when mated with a balanced cabling connector (plug) shall meet	40.8.3	M	Yes [ ]	Meet tThe electrical requirements for Category 5 connecting hardware for use with 100 Ω Category 5 cable as specified in ANSI/TIA/EIA-568-A:1995 and ISO/IEC 11801:1995.

42. System considerations for multisegment 1000 Mb/s networks

42.1.1 Single collision domain multisegment networks

Change first paragraph of 42.1.1 as follows:

This clause provides information on building 1000 Mb/s CSMA/CD multisegment networks within a single collision domain. The proper operation of a CSMA/CD network requires the physical size of the collision domain to be limited in order to meet the round-trip propagation delay requirements of 4.2.3.2.3 and 4.4.2~~4.4.2.1~~, and requires the number of repeaters to be limited to one so as not to exceed the InterFrameGap shrinkage noted in 4.4.2~~4.4.2.4~~.

43. Link aggregation

43.2.3.1.2 Variables

Change 43.2.3.1.2 as follows:

DA
SA
~~m_sdu~~ mac_service_data_unit
status
The parameters of the MA_DATA.indication primitive, as defined in Clause 2.

BEGIN
A Boolean variable that is set to TRUE when the System is initialized or reinitialized, and is set to FALSE when (re-)initialization has completed.
Value: Boolean

43.2.3.1.4 State diagram

Replace Figure 43–3 with the following:

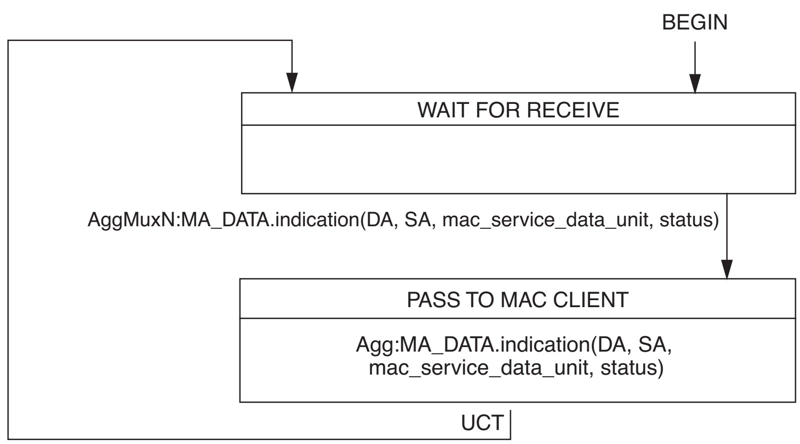


Figure 43–3—Frame Collector state diagram

43.2.4.1.1 Variables

Change 43.2.4.1.1 as follows:

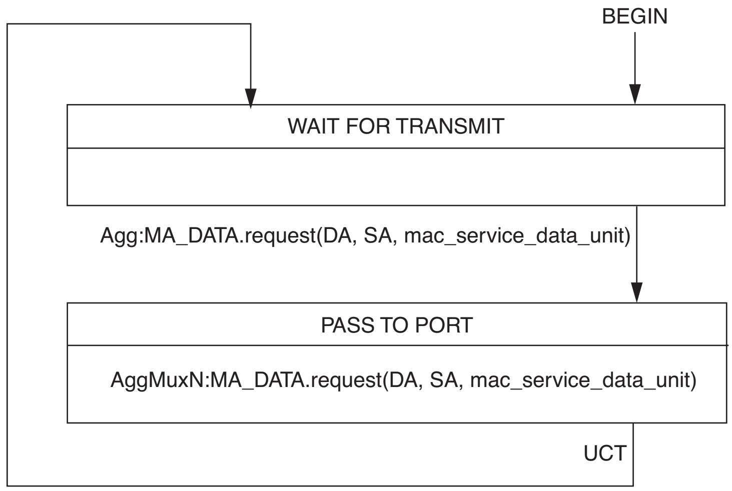
DA
SA
~~m_sdu~~ mac_service_data_unit
~~service_class~~
The parameters of the MA_DATA.request primitive, as defined in Clause 2.

BEGIN

A Boolean variable that is set to TRUE when the System is initialized or reinitialized, and is set to FALSE when (re-)initialization has completed.
Value: Boolean

43.2.4.1.3 State diagram

Replace Figure 43–4 with the following:



If a client issues an Agg:MA_DATA.request primitive that contains no SA parameter, the AggMuxN:MA_DATA.request primitive generated shall use the Aggregator's MAC address for the SA.

NOTE—The algorithm that the Frame Distributor uses to select the value of N in AggMuxN:MA_DATA.request for a given frame is unspecified.

Figure 43–4—Frame Distributor state diagram

43.2.5 Marker Generator/Receiver (optional)

Change 43.2.5 as follows:

The optional Marker Generator is used by the Marker protocol, as specified in 43.5. When implemented and so requested by the Distribution algorithm, the Marker Generator shall issue an AggMuxN:MA_DATA.request primitive, with an ~~m_sdu~~ mac_service_data_unit containing a Marker PDU as defined in 43.5.3, to the port associated with the conversation being marked, subject to the timing restrictions for Slow Protocols specified in Annex 43B.

The optional Marker Receiver is used by the Marker protocol, as specified in 43.5. It receives Marker Response PDUs from the Aggregator Parser.

43.2.7.1.2 Variables

Change 43.2.7.1.2 as follows:

DA
SA
~~m_sdu~~ <u>mac_service_data_unit</u>
status
The parameters of the MA_DATA.indication primitive as defined in Clause 2.

Length/Type
The value of the Length/Type field in a received frame.
Value: Integer

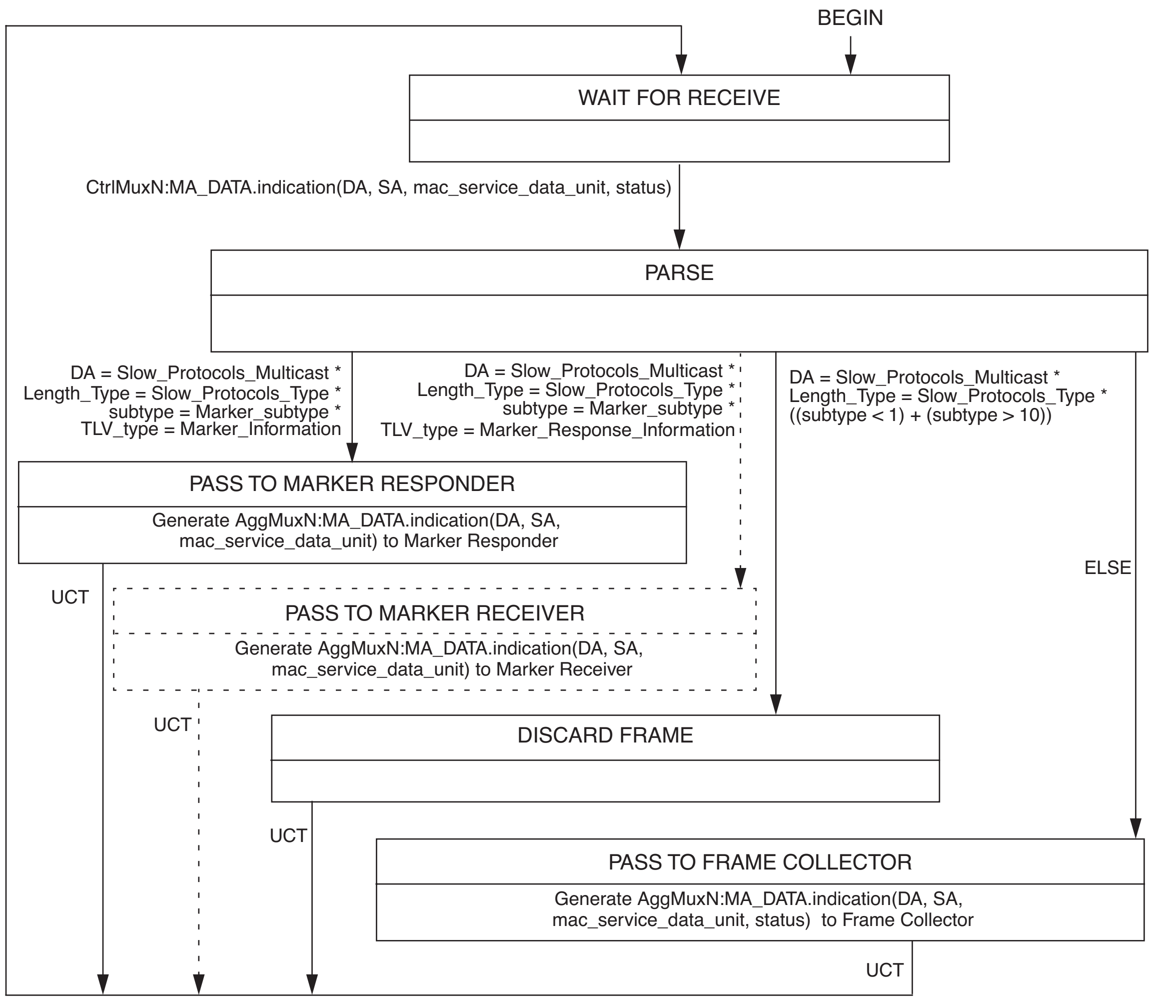
Subtype
The value of the octet following the Length/Type field in a Slow Protocol frame.
(See Annex 43B.)
Value: Integer

TLV_type
The value contained in the octet following the Version Number in a received Marker or Marker Response frame. This identifies the "type" for the Type/Length/Value (TLV) tuple. (See 43.5.3.)
Value: Integer

BEGIN
A Boolean variable that is set to TRUE when the System is initialized or reinitialized, and is set to FALSE when (re-)initialization has completed.
Value: Boolean

43.2.8.1 State diagram

Replace Figure 43–5 with the following:



If the optional Marker Receiver is not implemented, Marker Responses shall be passed to the Frame Collector. If the port state is not Collecting, all frames that would have been passed to the MAC Client through the Collector will be discarded.

Figure 43–5—Aggregator Parser state diagram

43.2.9.1.2 Variables

Change 43.2.9.1.2 as follows:

DA
SA
~~m_sdu~~ mac_service_data_unit
status
The parameters of the MA_DATA.indication primitive, as defined in Clause 2.

Length/Type
The value of the Length/Type field in a received frame.
Value: Integer

Subtype
The value of the octet following the Length/Type field in a Slow Protocol frame.
(See Annex 43B.)
Value: Integer

BEGIN
A Boolean variable that is set to TRUE when the System is initialized or reinitialized, and is set to FALSE when (re-)initialization has completed.
Value: Boolean

43.2.9.1.4 State diagram

Replace Figure 43–6 with the following:

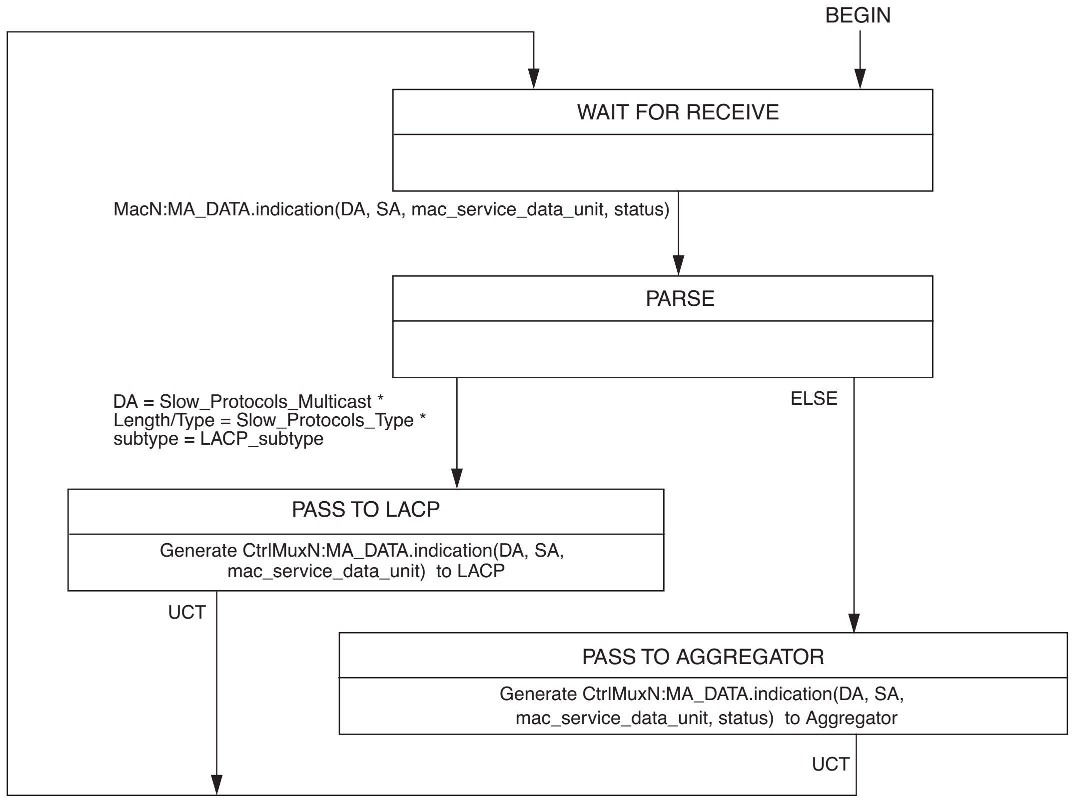


Figure 43–6—Control Parser state diagram

43.2.10 Addressing

Change the first paragraph of 43.2.10 as follows:

Each IEEE 802.3 MAC has an associated ~~globally unique~~ individual MAC address, whether that MAC is used for Link Aggregation or not (see Clause 4).

43.5.4.2.2 Variables

Change 43.5.4.2.2 as follows:

DA
SA
~~m_sdu~~ <u>mac_service_data_unit</u>
~~service_class~~
status

The parameters of the MA_DATA.request and MA_DATA.indication primitives, as defined in Clause 2.

43.5.4.2.3 Messages

Replace Figure 43–19 with the following:

.

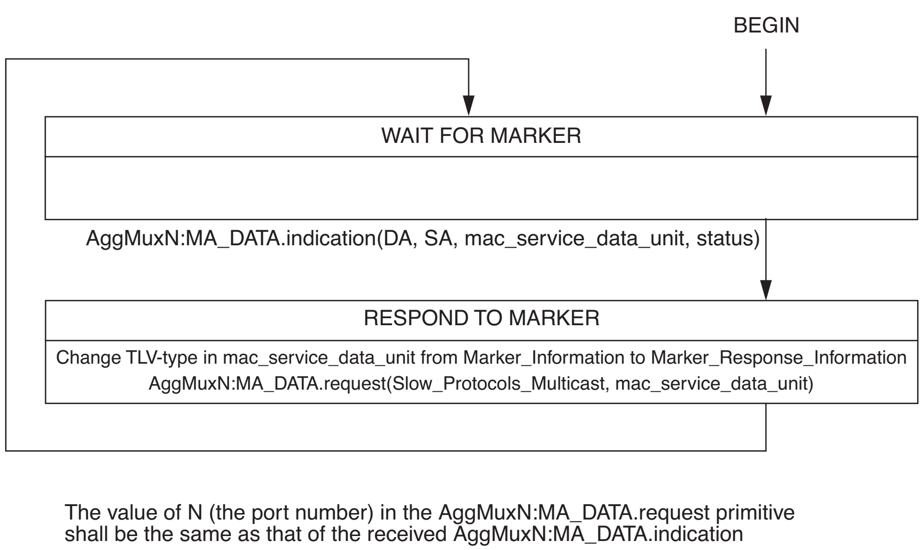


Figure 43–19—Marker Responder state diagram

45. Management Data Input/Output (MDIO) Interface

45.2.2.2 WIS status 1 register (Register 2.1)

Change Table 45–13 as follows:

Table 45–13—WIS status 1 register bit definitions

Bit(s)	Name	Description	R/W[a]
2.1.15:8	Reserved	Ignore when read	RO
2.1.7	Fault	1 = Fault condition 0 = No fault condition	RO/LH
2.1.6:3	Reserved	Ignore when read	RO
2.1.2	Link status	1 = WIS link up 0 = WIS link down	RO/LL
2.1.1	Low-power ability	1 = WIS supports low-power mode 0 = WIS does not support low-power mode	RO
~~2.1.1:0~~ 2.1.0	Reserved	Ignore when read	RO

[a]RO = Read Only, LH = Latching High, LL = Latching Low

47. XGMII Extender Sublayer (XGXS) and 10 Gigabit Attachment Unit Interface (XAUI)

47.3.3.4 Output impedance

Change 47.3.3.4 as follows:

For frequencies from 312.5 MHz to 3.125 GHz, the differential return loss of the driver shall exceed Equation (47-1). Differential return loss includes contributions from on-chip circuitry, chip packaging and any off-chip components related to the driver. This output impedance requirement applies to all valid output levels. The reference impedance for differential return loss measurements is 100 Ω.

$$s_{11} = -10 \text{ dB for } 312.5 \text{ MHz} < \text{Freq } (f) < 625 \text{ MHz, and} \quad (47\text{-}1)$$
$$-10 + 10\log(f/625) \text{ dB for } 625 \text{ MHz} <= \text{Freq } (f) = < 3.125 \text{ GHz}$$

where *f* is frequency in MHz.

47.3.3.5 Electrical characteristics

Change Item E4 of 47.3.3.4 as follows:

Item	Feature	Subclause	Value/Comment	Status	Support
E4	Driver output impedance	47.3.3.4	s_{11} = –10 dB for 312.5 MHz < Freq (*f*) < 625 MHz, and –10 + 10log(*f*/625) dB for 625 MHz <= Freq (*f*) = < 3.125 GHz (*f* is frequency in MHz)	M	Yes [ ]

49. Physical Coding Sublayer (PCS) for 64B/66B, type 10GBASE-R

49.2.14.2 Counters

Change 49.2.14.2 as follows:

The following counters are reset to zero upon read and upon reset of the PCS. When they reach all ones, they stop counting. Their purpose is to help monitor the quality of the link.

ber_count:
6-bit counter that counts each time BER_BAD_SH state is entered. This counter is reflected in MDIO register bits 3.33.13:8. Note that this counter counts a maximum of 16 counts per 125 µs since the BER_BAD_SH can be entered a maximum of 16 times per 125 µs window.

errored_block_count:
8-bit counter. When the receiver is in normal mode, errored_block_count counts once for each time RX_E state is entered. This counter is reflected in MDIO register bits 3.33.7:0.

test_pattern_error_count:
16-bit counter. When the receiver is in test-pattern mode, the test_pattern_error_count counts errors as described in 49.2.12. This counter is reflected in MDIO register bits ~~3.43.14:0~~ 3.43.15:0.

53. Physical Medium Dependent (PMD) sublayer and baseband medium, type 10GBASE-LX4

53.9.10.3 Transmit jitter test procedure

Change first paragraph of 53.9.10.3 as follows:

After setting up the test as described above, the BERT is scanned horizontally across the center of the eye from 0 unit intervals (UI) to 1 unit interval while measuring the error ~~rate~~ ratio to develop a BER "bathtub curve" as described in 53.8.1.1. This section also specifies the BER mask. It is not necessary to measure the error rate in the center of the eye where the BER is less than 10^{-12} or at the edges where the BER is worse than 10^{-4}. The mask natively includes those components of jitter (random, deterministic, bounded) historically measured independently.

Annex A

(informative)

Additional reference material

Change Annex A, [B17] as follows:

[B17] ANSI/TIA/EIA-568-B: 2001, Commercial Building Telecommunications Cabling Standard.

~~[B17] ANSI/TIA/EIA TSB95 (Proposed), Additional Transmission Performance Guidelines for 100 Ohm 4-Pair Category 5.~~

Annex B

(informative)

System guidelines

B.2.2 Minimum frame length determination

Change first paragraph of B.2.2 as follows:

The minimum frame length for 1BASE5 is determined using the values specified in 4.4.2~~4.4.2.2~~ and 12.9, applied to the following (worst) case:

B.2.3 Jitter budget

Change the seventh paragraph of B.2.3 as follows:

The two primary contributors to noise in a 1BASE5 cable are self-crosstalk and impulse noise (see 12.7.4). Because it is unlikely that both will be present at their 1% worst-case levels on any particular cable, the required bit error ~~rate~~ ratio attributable to each source can be set at half of the one in 10^8 error ~~rate~~ ratio required by 12.5.3.2.6.

Annex D

(informative)

Application context, selected medium specifications

D.6 10BASE-T use of cabling systems with a nominal differential characteristic impedance of 150 Ω

Change first and second paragraph of D.6 as follows:

This subclause outlines the philosophy and methodology for allowing 10BASE-T stations to support transmission on 150 Ω balanced STP cabling~~, installed in accordance with ANSI/TIA/EIA-568-A-1995 [B16], Clause 4, and~~ as specified by ISO/IEC 11801: 1995, Clause 8, with the use of impedance matching transformers.

The 10BASE-T specification was designed to support Manchester signaling over a link segment consisting of 100 Ω cabling system. The MAU link interface specifications were designed to ensure that jitter due to impedance discontinuities were minimized as specified in 14.4.2.3. In theory and in practice, a 150 Ω cabling system may be used to provide the link segment function provided the proper impedance match (100 Ω) with the MAU over the frequency range of interest as specified in 14.4, and the resultant transmission characteristics of the cabling system used to provide the link segment function meet or exceed those specified in 14.4. Therefore, to ensure the jitter specification of 14.4.2.3 and the jitter budget of B.4.1 are met, the following approach is recommended when using 150 Ω balanced STP cabling (as specified in ISO/IEC 11801: 1995):

a) The 150 Ω section included in the link segment shown in Figure D–1 meets the specifications of ISO/IEC 11801: 1995, 7.2~~, and ANSI/TIA/EIA-568-A-1995 [B16]~~.

Annex 30B

(normative)

GDMO and ASN.1 definitions for management

30B.2 ASN.1 module for CSMA/CD managed objects

Change 30B.2 (as modified by IEEE Std 802.3ae-2002), MediaAvialState as follows:

MediaAvailState::= ENUMERATED {

other	(1),	--undefined
unknown	(2),	--initializing, true state not yet known
available	(3),	--link or light normal, loopback normal
not available	(4),	--link loss or low light, no loopback
remote fault	(5),	--remote fault with no detail
invalid signal	(6),	--invalid signal, applies only to 10BASE-FB
remote jabber	(7),	--remote fault, reason known to be jabber
remote link loss	(8),	--remote fault, reason known to be far-end link loss
remote test	(9),	--remote fault, reason known to be test
offline	(10),	--offline, applies only to Clause 37 Auto-Negotiation
auto neg error	(11)	--Auto-Negotiation error, applies only to Clause 37 Auto-Negotiation
PMD link fault	(12)	--PMD/PMD receive link fault
WIS frame loss	(13)	--WIS loss of frame, applies only to 10GBASE-W
WIS signal loss	(14)	--WIS loss of signal, applies only to 10GBASE-W
PCS link fault	(15)	--PCS receive link fault
excessive BER	(16)	--PCS Bit Error ~~Rate~~ Ratio monitor reporting excessive error ~~rate~~ ratio
DXS link fault	(17)	--DTE XS receive link fault, applies only to XAUI
PXS link fault	(18)	--PHY XS transmit link fault, applies only to XAUI

}

Annex 31B

(normative)

MAC Control PAUSE operation

31B.3.4.2 Variables

Change 31B.3.4.2 as follows:

n_quanta_rx
: An integer used to extract the number of pause quanta to set the pause_timer from the dataParam of the received frame.

opcode
: The opcode parsed from the received frame.

DA
: The destination address from the ReceiveFrame function.

data
: The data payload field parsed from the received frame.

transmission_in_progress
: A boolean used by the Transmit State Machine to indicate that a TransmitFrame function call is pending.

Values: true; transmission is in progress
false; transmission is not in progress

31B.3.6.3 Messages

Change 31B.3.6.3 as follows:

MA_CONTROL.indication
: The service primitive used to indicate the state of the MAC Control sublayer to its client.

Replace Figure 31B-2 with the following:

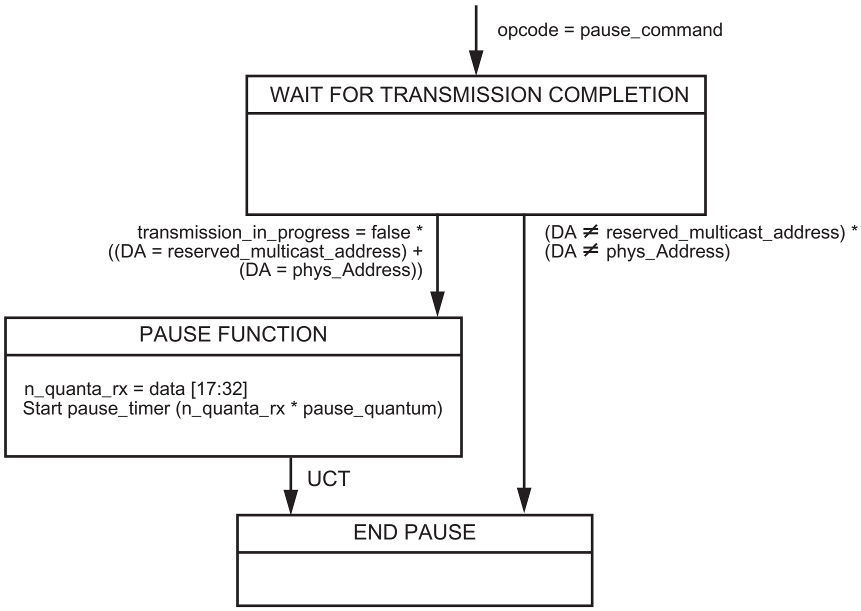


Figure 31B–2—PAUSE Operation Receive state diagram

31B.4.6 PAUSE command MAC timing considerations

Change item TIM2 in 31B.4.6 as follows:

Item	Feature	Subclause	Value/Comment	Status	Support
TIM1	Effect of PAUSE frame on a frame already submitted to underlying MAC	31B.3.7	Has no effect	M	Yes [ ]
	Delay from receiving valid PAUSE command, with non-zero value for pause_time, to cessation of transmission	31B.3.7	Measured as described		
TIM2	Measurement point for station with MII		Delay at ~~MDI~~ MII ≤ pause_quantum bits	MIIa: M	N/A [ ] M: Yes [ ]
TIM3	Measurement point for station without MII at 100 Mb/s or less		Delay at MDI ≤ (pause_quantum + 64) bits	MIIb: M	N/A [ ] M: Yes [ ]
TIM4	Measurement point for station at 1000 Mb/s		Delay at MDI ≤ (2 × pause_quantum) bits	MIIc: M	N/A [ ] M: Yes [ ]
TIM5	Measurement point for station at 10 Gb/s or greater		Delay at MDI ≤ (60 × pause_quantum) bits	MIId: M	N/A [ ] M: Yes [ ]

Annex 40A

(informative)

Additional cabling design guidelines

Change first paragraph of 40A as follows:

This annex provides additional cabling guidelines when installing a new Category 5/Class D balanced cabling system or using an existing Category 5/Class D balanced cabling system. These guidelines are intended to supplement those in Clause 40. 1000BASE-T is designed to operate over 4-pair unshielded twisted-pair cabling systems that meet ~~both~~ the ~~Category 5~~ requirements described in ANSI/TIA/EIA-568-A ~~(~~1995~~)~~ (Category 5) and ISO/IEC 11801:1995 (Class D), and the additional transmission parameters of return loss, ELFEXT loss, and MDELFEXT loss specified in 40.7. There are additional steps that may be taken by network designers that provide additional operating margins and ensure the objective BER of 10^{-10} is achieved. Cabling systems that meet or exceed the specifications in 40.7 for a worst case 4-connector topology are recommended for new installations. Whether installing a new Category 5/Class D balanced cabling system or reusing one that is already installed, it is *highly recommended* that the cabling system be measured/certified before connecting 1000BASE-T equipment following the guidelines in ANSI/EIA/TIA 568-B1 Annex D ~~(proposed) ANSI/TIA/EIA TSB95~~.

40A.2 Cabling configurations

Change first paragraph of 40A.2 as follows:

The primary application for the Clause 40 specification is expected to be between a workstation and the local telecommunications closet. In commercial buildings this application is generally referred to as the horizontal cabling subsystem. As specified in ~~ANSI/TIA/EIA-568-A and~~ ISO/IEC 11801: 1995 the maximum length of a horizontal subsystem building wiring channel is 100 m. The channel consists of cords, cables, and connecting hardware. The maximum configuration for this channel is shown in Figure 40A–1.

Annex 48B

(informative)

Jitter test methods

48B.1 BER and jitter model

Change the first paragraph of 48.B.1 as follows:

Measurement of BER within a data eye is not only the fundamental indicator of signal quality, it is a valuable tool to infer jitter properties. Insight into the relationship between jitter, eye opening and error ~~rate~~ ratio can be gained through mathematical modeling.

Annex 50A

(informative)

Thresholds for Severely Errored Second calculations

Change first paragraph of 50A as follows:

This annex provides tables of threshold values that may be used to determine the generation of Section, Line and Path Severely Errored Second (SES) events for various error rates. An SES event is deemed to have occurred when the number of bit errors, detected via the corresponding Bit Interleaved Parity (BIP) check, exceeds some predefined threshold value when accumulated over a 1 second interval; reporting of an SES event indicates that the actual bit error ~~rate~~ ratio on the medium has increased to a point where Station Management must be notified. These threshold values are referred to as *x* in the Layer Management definitions in Clause 30. This annex also defines the terms "Path Block Error" and "Far End Path Block Error."