segments using similar or dissimilar PHY implementations (e.g., 100BASE-X to 100BASE-X, 100BASE-X to 100BASE-T4, etc.). (See IEEE 802.3 clauses 9 and 27.)

1.4.164 Return Loss: In 10BROAD36, the ratio in decibels of the power reflected from a port to the power incident to the port. An indicator of impedance matching in a broadband system. (See IEEE 802.3 clause 11.)

1.4.165 router: A layer 3 interconnection device that appears as a MAC to a CSMA/CD collision domain. (See IEEE Std 610.7-1995 [A16].)

1.4.166 Seed: In 10BROAD36, the 23 bits residing in the scrambler shift register prior to the transmission of a packet. (See IEEE 802.3 clause 11.)

1.4.167 Segment Delay Value (SDV): A number associated with a given segment that represents the delay on that segment including repeaters and end stations, if present, used to assess path delays for 10 Mb/s CSMA/CD networks. (See IEEE 802.3, 13.4.)

1.4.168 Segment Variability Value (SVV): A number associated with a given segment that represents the delay variability on that segment (including a repeater) for 10 Mb/s CSMA/CD networks. The SVVs for different segment types are specified in IEEE 802.3 table 13-3. (See IEEE 802.3, 13.4.)

1.4.169 segment: The medium connection, including connectors, between MDIs in a CSMA/CD LAN.

1.4.170 Selector field: A five-bit field in the Base Link Code Word encoding that is used to encode up to 32 types of messages that define basic abilities. For example, selector field 00001 indicates that the base technology is IEEE 802.3. (See IEEE 802.3 clause 28.)

1.4.171 shared service: A CSMA/CD network in which the collision domain consists of more than two DTEs so that the total network bandwidth is shared among them.

1.4.172 shielded twisted-pair (STP) cable: An electrically conducting cable, comprising one or more elements, each of which is individually shielded. There may be an overall shield, in which case the cable is referred to as shielded twisted pair cable with an overall shield. (From ISO/IEC 11801: 1995.) Specifically for IEEE 802.3 100BASE-TX, 150 Ω balanced inside cable with performance characteristics specified to 100 MHz (i.e., performance to Class D link standards as per ISO/IEC 11801: 1995). In addition to the requirements specified in ISO/IEC 11801: 1995, IEEE 802.3 clauses 23 and 25 provide additional performance requirements for 100BASE-T operation over STP.

1.4.173 Simplex Fiber Optic Link Segment: A single fiber path between two MAUs or PHYs, including the terminating connectors, consisting of one or more fibers joined serially with appropriate connection devices, for example, patch cables and wall plates. (See IEEE 802.3 clause 15.)

1.4.174 simplex link segment: A path between two MDIs, including the terminating connectors, consisting of one or more segments of twisted pair cable joined serially with appropriate connection devices, for example, patch cords and wall plates. (See IEEE 802.3 figure 14-2.)

1.4.175 skew between pairs: The difference in arrival times of two initially coincident signals propagated over two different pairs, as measured at the receiving end of the cable. Total skew includes contributions from transmitter circuits as well as the cable.

1.4.176 special link (SL): A transmission system that replaces the normal medium. (See IEEE 802.3, 12.8.)

1.4.177 Spectral Width, Full-Width Half Maximum (FWHM): The absolute difference between the wavelengths at which the spectral radiant intensity is 50% of the maximum. (See IEEE 802.3 clause 15.)

1.4.178 spectrum mask: A graphic representation of the required power distribution as a function of frequency for a modulated transmission.

1.4.179 star quad: A cable element that comprises four insulated connectors twisted together. Two diametrically facing conductors form a transmission pair. *Note*—Cables containing star quads can be used interchangeably with cables consisting of pairs, provided the electrical characteristics meet the same specifications. (From ISO/IEC 11801: 1995.)

1.4.180 Start-of-Stream Delimiter (SSD): A pattern of defined code words used to delineate the boundary of a data transmission sequence on the Physical Layer stream. The SSD is unique in that it may be recognized independent of previously defined code-group boundaries and it defines subsequent code-group boundaries for the stream it delimits. For 100BASE-T4, SSD is a pattern of three predefined sosb code-groups (one per wire pair) indicating the positions of the first data code-group on each wire pair. For 100BASE-X, SSD consists of the code-group sequence /J/K/.

1.4.181 stream: The Physical Layer encapsulation of a MAC frame. Depending on the particular PHY, the MAC frame may be modified or have information appended or prepended to it to facilitate transfer through the PMA. Any conversion from a MAC frame to a PHY stream and back to a MAC frame is transparent to the MAC. (See IEEE 802.3 clauses 23 and 24.)

1.4.182 symbol: The smallest unit of data transmission on the medium. Symbols are unique to the coding system employed. 100BASE-T4 uses ternary symbols; 10BASE-T and 100BASE-X use binary symbols or code bits.

1.4.183 symbol rate (SR): The total number of symbols per second transferred to or from the Media Dependent Interface (MDI) on a single wire pair. For 100BASE-T4, the symbol rate is 25 megabaud; for 100BASE-X, the symbol rate is 125 megabaud.

1.4.184 symbol time (ST): The duration of one symbol as transferred to and from the MDI via a single wire pair. The symbol time is the reciprocal of the symbol rate.

1.4.185 Technology Ability Field: An eight-bit field in the Auto-Negotiation base page that is used to indicate the abilities of a local station, such as support for 10BASE-T, 100BASE-TX, 100BASE-T4, as well as full-duplex capabilities.

1.4.186 ternary symbol: In 100BASE-T4, a ternary data element. A ternary symbol can have one of three values: –1, 0, or +1. (See IEEE 802.3 clause 23.)

1.4.187 translation: In a single-cable 10BROAD36 system, the process by which incoming transmissions at one frequency are converted into another frequency for outgoing transmission. The translation takes place at the headend. (See IEEE 802.3 clause 11.)

1.4.188 truncation loss: In a modulated data waveform, the power difference before and after implementation filtering necessary to constrain its spectrum to a specified frequency band.

1.4.189 trunk cable: The main (often large diameter) cable of a coaxial cable system. (*See:* **drop cable**.)

1.4.190 twisted-pair cable binder group: A group of twisted pairs within a cable that are bound together. Large telephone cables have multiple binder groups with high interbinder group near-end crosstalk loss.

1.4.191 twisted-pair cable: A bundle of multiple twisted pairs within a single protective sheath. (From ISO/IEC 11801: 1995.)

1.4.192 twisted-pair link: A twisted-pair cable plus connecting hardware. (From ISO/IEC 11801: 1995.)

1.4.193 twisted-pair link segment: In 100BASE-T, a twisted-pair link for connecting two PHYs.

1.4.194 twisted pair: A cable element that consists of two insulated conductors twisted together in a regular fashion to form a balanced transmission line. (From ISO/IEC 11801: 1995.)

1.4.195 Unformatted Page (UP): A Next Page encoding that contains an unformatted 12-bit message field. Use of this field is defined through Message Codes and information contained in the UP. (See IEEE 802.3, 28.2.1.2.)

1.4.196 unshielded twisted-pair cable (UTP): An electrically conducting cable, comprising one or more pairs, none of which is shielded. There may be an overall shield, in which case the cable is referred to as unshielded twisted pair with overall shield. (From ISO/IEC 11801: 1995.)

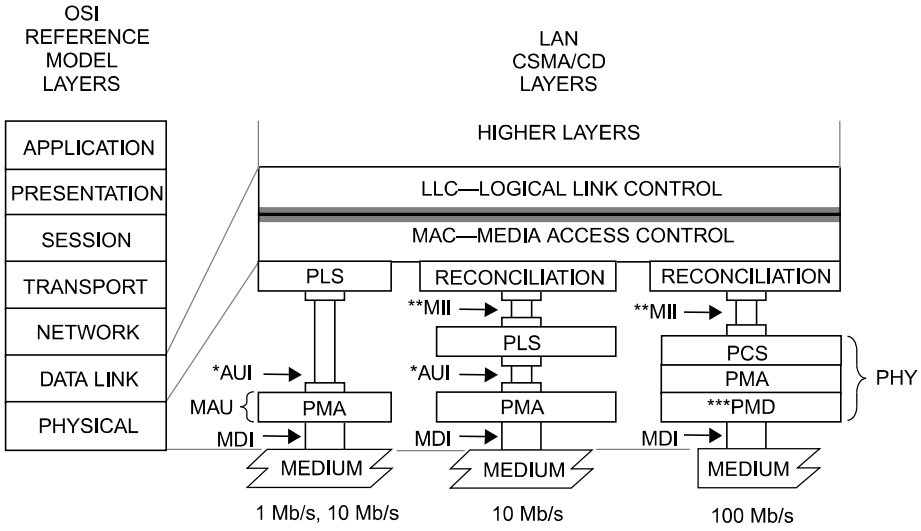
1.4.197 weight of 6T code group: The algebraic sum of the logical ternary symbol values listed in the 100BASE-T4 8B6T code table. (See IEEE 802.3 clause 23.)

Remove the definitions from 7.1.1, 8.1.2, 9.2, 10.1.2, 11.1.2, 12.1.3, 13.2, 14.1.2, 15.1.2, and 19.1.3 and insert the following text under each of these subclauses:

See 1.4.

2. MAC service specification

Replace figure 2-1 with the following:



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

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

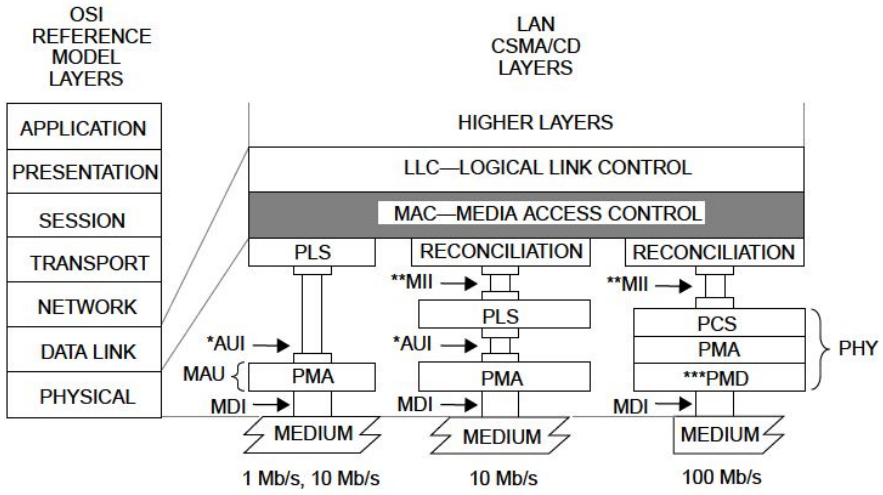
NOTE—The three types of layers below the MAC sublayer are mutually independent.

* AUI is optional for 10 Mb/s systems and is not specified for 1 Mb/s and 100 Mb/s systems.
** MII is optional for 10 Mb/s DTEs and for 100 Mb/s systems and is not specified for 1 Mb/s systems.
*** PMD is specified for 100BASE-X only; 100BASE-T4 does not use this layer.
For an exposed AUI residing below an MII, see 22.5.

Figure 2-1—Service specification relation to the LAN model

4. Media Access Control

Replace figure 4-1 with the following:



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

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

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

* AUI is optional for 10 Mb/s systems and is not specified for 1 Mb/s and 100 Mb/s systems.
** MII is optional for 10 Mb/s DTEs and for 100 Mb/s systems and is not specified for 1 Mb/s systems.
*** PMD is specified for 100BASE-X only; 100BASE-T4 does not use this layer.
For an exposed AUI residing below an MII, see 22.5.

Figure 4-1—MAC sublayer partitioning, relationship to the ISO Open Systems Interconnection (OSI) reference model

Add to 4.4.2 the following subclause:

4.4.2.3 Parameterized values

The following parameter values shall be used for 100 Mb/s implementations:

Parameters	Values
slotTime	512 bit times
interFrameGap	0.96 µs
attemptLimit	16
backoffLimit	10
jamSize	32 bits
maxFrameSize	1518 octets
minFrameSize	512 bits (64 octets)
addressSize	48 bits

WARNING—Any deviation from the above specified values may affect proper operation of the network.

5. Layer management

Insert before 5.1:

Clause 5 is deprecated by clause 30.

14. Twisted-pair Medium Attachment Unit (MAU) and baseband medium, Type 10BASE-T

EDITORIAL NOTE—The following changes add references to Auto-Negotiation and specifications for Auto-Negotiation to the appropriate places in clause 14 of ISO/IEC 8802-3: 1993 [ANSI/IEEE Std 802.3-1993 Edition] and IEEE Std 802.3l-1992. (These changes will also identically affect the 1995 edition of ISO/IEC 8802-3.) The changes do not alter the specifications for existing systems.

In 14.2, renumber the list items (1) through (7) as a) through g) and add the following paragraph as the eighth functional capability:

h) Auto-Negotiation. Optionally provides the capability for a device at one end of a link segment to advertise its abilities to the device at the other end (its link partner), to detect information defining the abilities of the link partner, and to determine if the two devices are compatable.

Add to 14.2.1 the following sentence to the end of the paragraph:

The MAU may optionally provide the Auto-Negotiation algorithm. When provided, the Auto-Negotiation algorithm shall be implemented in accordance with clause 28.

Add to 14.2.1.1 the following paragraph after the fourth paragraph:

For a MAU that implements the Auto-Negotiation algorithm defined in clause 28, clause 28 shall define the allowable transmitted link pulse sequence.

Add to 14.2.1.7 the following sentence at the end of the fourth paragraph:

For a MAU that implements the Auto-Negotiation algorithm defined in clause 28, the MAU shall enter the LINK TEST FAIL RESET state at power-on as specified in clause 28. For a MAU that does not implement the Auto-Negotiation algorithm defined in clause 28, it is highly recommended that it also power-on in the LINK TEST FAIL RESET state, although implementations may power-on in the LINK TEST PASS state. For a MAU that implements the Auto-Negotiation function defined in clause 28, the Auto-Negotiation Technology Dependent Interface shall be supported. Supporting the Technology Dependent Interface requires that in the Link Integrity Test function state diagram 'link_status=OK' is added to the LINK TEST PASS state and 'link_status=FAIL' is added to the LINK TEST FAIL RESET state. Note these ISO message variables follow the conventions of clause 21.

Add to 14.3.1.2.1 the following paragraph after the sixth paragraph:

For a MAU that implements the Auto-Negotiation algorithm defined in clause 28, the FLP Burst Sequence will consist of multiple link test pulses. All link test pulses in the FLP Burst sequence shall meet the template requirements of figure 14-12 when measured across each of the test loads defined in figure 14-11; both with the load connected directly to the TD circuit and with the load connected through the twisted-pair model as defined in figures 14-7 and 14-8.

Add to 14.10.4.5.1 the following entry as the eighth parameter:

	Parameter	Section	Req	Imp	Value/Comment
8	Auto-Negotiation		C		Function provided by MAUs implementing the Auto-Negotiation algorithm, as defined in clause 28

Add this new subclause after 14.10.4.7:

14.10.4.8 PICS proforma tables for Auto-Negotiation-able MAUs

The following are conditional on whether the Auto-Negotiation algorithm is provided (clause 28).

	Parameter	Section	Req	Imp	Value/Comment
1	TP_IDL	14.2.1.1	C		Defined in clause 28.2.1
2	Link Integrity Test Function State Diagram power-on default	14.2.1.7	C		Power-on in Link Test Fail Reset state
3	Link Test Fail state exit conditions	14.2.1.7	C		autoneg_wait_timer expired and either RD = active or consecutive link test pulses = 3 min., 10 max
4	Technology Dependent Interface support	14.2.1.7	C		In the Link Integrity Test state diagram function 'link_status=OK' is added to the LINK TEST PASS state and 'link_status=FAIL' is added to the LINK TEST FAIL RESET state
5	Link test pulse waveform for FLP Burst with and without twisted-pair model	14.3.1.2.1	C		Within figure 14-10 template for, all pulses in FLP Burst, overshoot ≤ +50 mV after excursion below –50 mV

19. Layer management for 10 Mb/s baseband repeaters

EDITORIAL NOTE—This clause can be found in IEEE Std 802.3k-1992.

Insert the following phrase in front of 19.1:

Clause 19 is deprecated by clause 30.

20. Layer management for 10 Mb/s baseband Medium Attachment Units (MAUs)

EDITORIAL NOTE—This clause can be found in IEEE Stds 802.3p&q-1993.

Insert the following phrase in front of 20.1:

Clause 20 is deprecated by clause 30.

Annex A

(informative)[11]

Additional reference material

EDITORIAL NOTES

1—This clause was changed from Annex to Annex A by IEEE Std 802.3j-1993.

2—In the following references, changes are not indicated by strikethroughs and underscores.

3—The reference numbers in this annex do not correspond to those of ISO/IEC 8802-3: 1993 or the 1995 edition of ISO/IEC 8802-3.

Replace annex A with the following:

[A1] ANSI/EIA 364A: 1987, Standard Test Procedures for Low-Frequency (Below 3 MHz) Electrical Connector Test Procedure.

[A2] ANSI/EIA 455-34: 1985, Fiber Optics—Interconnection Device Insertion Loss Test.

[A3] ANSI/EIA/TIA 455-59-1989, Measurement of Fiber Point Defects Using an Optical Time Domain Reflectometer (ODTR).

[A4] ANSI/EIA/TIA 455-180-1990, FOTP-180, Measurement of the Optical Transfer Coefficients of a Passive Branching Device (Coupler).

[A5] ANSI/EIA/TIA 526-14-1990, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

[A6] ANSI/EIA/TIA 568-1991, Commercial Building Telecommunications Wiring Standard.

[A7] ANSI/IEEE Std 770X3.97-1983, IEEE Standard Pascal Computer Programming Language.[12]

[A8] ANSI/NFPA 70-1993, National Electrical Code.

[A9] ANSI/UL 94-1990, Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

[A10] ANSI/UL 114-1982, Safety Standard for Office Appliances and Business Equipment.[13]

[11]This annex is informative for the International Standard but normative for IEEE Std 802.3.

[12]ANSI/IEEE Std 770X3.97-1983 has been withdrawn; however, copies can be obtained from Global Engineering, 15 Inverness Way East, Englewood, CO 80112-5704, USA, tel. (303) 792-2181.

[13]ANSI/UL 114-1982 was withdrawn and replaced by ANSI/UL 1950-1994.

[A11] ANSI/UL 478-1979, Safety Standard for Electronic Data-Processing Units and Systems.[14]

[A12] ANSI/UL 1950-1994, Safety Standard for Information Technology Equipment Including Electrical Business Equipment.

[A13] ECMA-97 (1985), Local Area Networks Safety Requirements.

[A14] EIA CB8-1981, Components Bulletin (Cat 4) List of Approved Agencies, US and Other Countries, Impacting Electronic Components and Equipment.

[A15] FCC Docket 20780-1980 (Part 15), Technical Standards for Computing Equipment. Amendment of Part 15 to redefine and clarify the rules governing restricted radiation devices and low-power communication devices. Reconsidered First Report and Order, April 1980.

[A16] IEEE Std 610.7-1995, IEEE Standard Glossary of Computer Networking Terminology.

[A17] IEEE Std 802.9a-1995, IEEE Standards for Local and Metropolitan Area Networks: Integrated Services (IS) LAN: IEEE 802.9 Isochronous Services with Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Media Access Control (MAC) Service.[15]

[A18] IEEE P1394/D8.0v3, Draft Standard for a High-Performance Serial Bus (July 7, 1995).

[A19] MIL-C-17F-1983, General Specification for Cables, Radio Frequency, Flexible and Semirigid.

[A20] MIL-C-24308B-1983, General Specifications for Connector, Electric, Rectangular, Miniature Polarized Shell, Rack and Panel.

[A21] AMP, Inc., Departmental Publication 5525, Design Guide to Coaxial Taps. Harrisburg, PA 17105, USA.

[A22] AMP, Inc., Instruction Sheet 6814, Active Tap Installation. Harrisburg, PA 17105, USA.

[A23] Brinch Hansen, P. *The Architecture of Concurrent Programs.* Englewood Cliffs, NJ: Prentice Hall, 1977.

[A24] Digital Equipment Corporation, Intel, Xerox, The Ethernet, Version 2.0, November 1982.

[A25] Hammond, J. L., Brown, J. E., and Liu, S. S. Development of a Transmission Error Model and Error Control Model. Technical Report RADC-TR-75-138. Rome: Air Development Center (1975).

[A26] Shoch, J. F., Dalal, Y. K., Redell, D. D., and Crane, R. C., "The Evolution of Ethernet," *Computer Magazine*, August 1982.

[A27] UL Subject No 758: UL VW-1, Description of Appliance Wiring Material.

[14]ANSI/UL 478-1979 was withdrawn and replaced by ANSI/UL 1950-1994.

[15]As this standard goes to press, IEEE Std 802.9a-1995 is approved but not yet published. The approved draft standard is, however, available from the IEEE. Anticipated publication date is early 1996. Contact the IEEE Standards Department at 1 (908) 562-3800 for status information.

Annex D

(normative)

GDMO specifications for CSMA/CD managed objects

EDITORIAL NOTE—This annex can be found in IEEE Stds 802.3p&q-1993.

Insert the following note at three places immediately following the headings D1, D2, and D3:

NOTE—The arcs (that is, object identifier values) defined in annex 30A deprecate the arcs previously defined in D1 (Layer Management), D2 (Repeater Management), and D3 (MAU Management). See IEEE Std 802.1F-1993, annex C4.

IEEE Standards for Local and Metropolitan Area Networks:

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

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

21. Introduction to 100 Mb/s baseband networks, type 100BASE-T

21.1 Overview

100BASE-T couples the ISO/IEC 8802-3 CSMA/CD MAC with a family of 100 Mb/s Physical Layers. While the MAC can be readily scaled to higher performance levels, new Physical Layer standards are required for 100 Mb/s operation.

The relationships between 100BASE-T, the existing ISO/IEC 8802-3 (CSMA/CD MAC), and the ISO Open System Interconnection (OSI) reference model is shown in figure 21-1.

100BASE-T uses the existing ISO/IEC 8802-3 MAC layer interface, connected through a Media-Independent Interface layer to a Physical Layer entity (PHY) sublayer such as 100BASE-T4, 100BASE-TX, or 100BASE-FX.

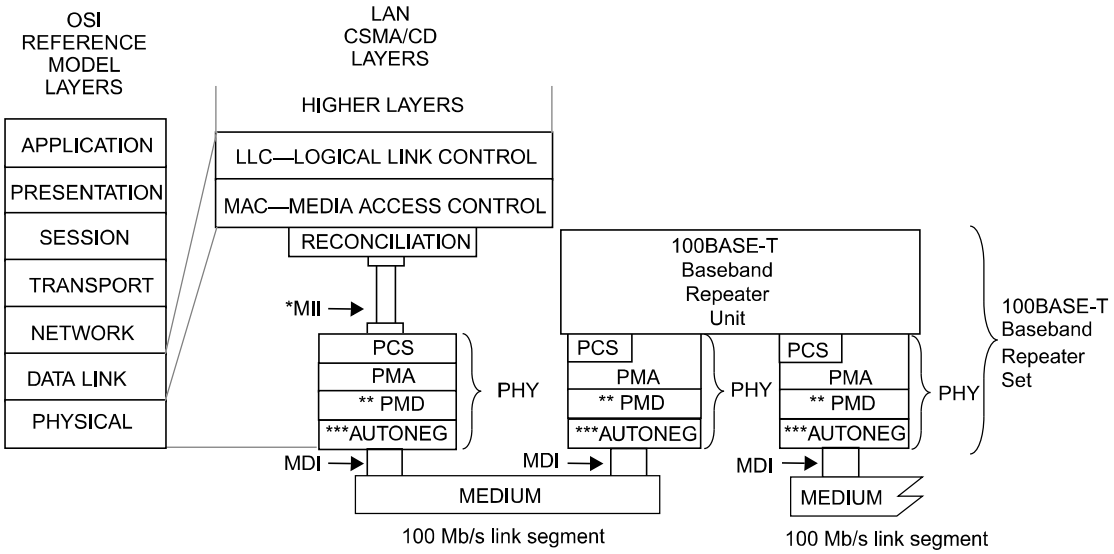
100BASE-T extends the ISO/IEC 8802-3 MAC to 100 Mb/s. The bit rate is faster, bit times are shorter, packet transmission times are reduced, and cable delay budgets are smaller—all in proportion to the change in bandwidth. This means that the ratio of packet duration to network propagation delay for 100BASE-T is the same as for 10BASE-T.

21.1.1 Reconciliation Sublayer (RS) and Media Independent Interface (MII)

The Media Independent Interface (clause 22) provides an interconnection between the Media Access Control (MAC) sublayer and Physical Layer entities (PHY) and between PHY Layer and Station Management (STA) entities. This MII is capable of supporting both 10 Mb/s and 100 Mb/s data rates through four bit wide (nibble wide) transmit and receive paths. The Reconciliation sublayer provides a mapping between the signals provided at the MII and the MAC/PLS service definition.

21.1.2 Physical Layer signaling systems

This standard specifies a family of Physical Layer implementations. 100BASE-T4 (clause 23) uses four pairs of ISO/IEC 11801: 1995 Category 3, 4, or 5 balanced cable. 100BASE-TX (clauses 24 and 25) uses two pairs of Category 5 balanced cable or 150 Ω shielded balanced cable as defined by ISO/IEC 11801: 1995. 100BASE-FX (clauses 24 and 26) uses two multi-mode fibers. FDDI (ISO 9314 and ANSI X3T12) Physical Layers are used to provide 100BASE-TX and 100BASE-FX physical signaling channels, which are defined in 100BASE-X (clause 24).



MDI = MEDIUM DEPENDENT INTERFACE
MII = MEDIA INDEPENDENT INTERFACE

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

* MII is optional for 10 Mb/s DTEs and for 100 Mb/s systems and is not specified for 1 Mb/s systems.
** PMD is specified for 100BASE-X only; 100BASE-T4 does not use this layer.
Use of MII between PCS and Baseband Repeater Unit is optional.
*** AUTONEG is optional.

Figure 21-1—Architectural positioning of 100BASE-T

21.1.3 Repeater

Repeater sets (clause 27) are an integral part of any 100BASE-T network with more than two DTEs in a collision domain. They extend the physical system topology by coupling two or more segments. Multiple repeaters are permitted within a single collision domain to provide the maximum path length.

21.1.4 Auto-Negotiation

Auto-Negotiation (clause 28) provides a linked device with the capability to detect the abilities (modes of operation) supported by the device at the other end of the link, determine common abilities, and configure for joint operation. Auto-Negotiation is performed out-of-band using a pulse code sequence that is compatible with the 10BASE-T link integrity test sequence.

21.1.5 Management

Managed objects, attributes, and actions are defined for all 100BASE-T components (clause 30). This clause consolidates all IEEE 802.3 management specifications so that 10 Mb/s, 100 Mb/s or 10/100 Mb/s agents can be managed by existing 10 Mb/s-only network management stations with little or no modification to the agent code.

21.2 Abbreviations

This document contains the following abbreviations:

8802-3	ISO/IEC 8802-3 (IEEE Std 802.3)
8802-5	ISO/IEC 8802-5 (IEEE Std 802.5)
ASIC	application-specific integrated circuit
ASN.1	abstract syntax notation one as defined in ISO/IEC 8824: 1990
AUI	attachment unit interface
BPSK	binary phase shift keying
BR	bit rate
BT	bit time
CAT3	Category 3 balanced cable
CAT4	Category 4 balanced cable
CAT5	Category 5 balanced cable
CD0	clocked data zero
CD1	clocked data one
CMIP	common management information protocol as defined in ISO/IEC 9596-1: 1991
CMIS	common management information service as defined in ISO/IEC 9595: 1991
CMOS	complimentary metal oxide semiconductor
CRC	cyclic redundancy check
CVH	clocked violation high
CVL	clocked violation low
CRV	code rule violation
CS0	control signal zero
CS1	control signal one
CW	continuous wave
DTE	data terminal equipment
ELFEXT	equal-level far-end crosstalk
ESD	end of stream delimiter
FCS	frame check sequence
FDDI	fibre distributed data interface
FEXT	far-end crosstalk
FIFO	first in, first out
FLP	fast link pulse
FOIRL	fiber optic inter-repeater link
FOMAU	fiber optic medium attachment unit
FOMDI	fiber optic medium dependent interface
FOPMA	fiber optic physical medium attachment
HH	header hub
IH	intermediate hub
IPG	inter-packet gap
IRL	inter-repeater link
LAN	local area network
LLC	logical link control
LSDV	link segment delay value
MAC	medium access control
MAU	medium attachment unit
MC	message code
MDELFEXT	multiple-disturber equal-level far-end crosstalk
MDFEXT	multiple-disturber far-end crosstalk
MDI	medium dependent interface
MDNEXT	multiple-disturber near-end crosstalk
MIB	management information base

MII	media independent interface
MP	message page
NEXT	near-end crosstalk
NLP	normal link pulse
NPA	next page algorithm
NRZI	non return to zero and invert on ones
PCS	physical coding sublayer
PDV	path delay value
PHY	Physical Layer entity sublayer
PICS	protocol implementation conformance statement
PLS	physical signaling sublayer
PMA	physical medium attachment
PMD	physical medium dependent
PMI	physical medium independent
PVV	path variability value
RS	reconciliation sublayer
SSD	start-of-stream delimiter
SDV	segment delay value
SFD	start-of-frame delimiter
SR	symbol rate
ST	symbol time
STA	station management entity
STP	shielded twisted pair (copper)
SVV	segment variability value
UCT	unconditional transition
UP	unformatted page
UTP	unshielded twisted pair

21.3 References

References are shown beginning on pages 2 and 23 of this document (as updates to 1.3 and annex A).

21.4 Definitions

Definitions are shown beginning on page 5 of this document (as an update to 1.4).

21.5 State diagrams

State machine diagrams take precedence over text.

The conventions of 1.2 are adopted, with the following extensions.

21.5.1 Actions inside state blocks

The actions inside a state block execute instantaneously. Actions inside state blocks are atomic (i.e., uninterruptible).

After performing all the actions listed in a state block one time, the state block then continuously evaluates its exit conditions until one is satisfied, at which point control passes through a transition arrow to the next block. While the state awaits fulfillment of one of its exit conditions, the actions inside do not implicitly repeat.

The characters • and [bracket] are *not* used to denote any special meaning.

Valid state actions may include .indicate and request messages.

No actions are taken outside of any state block.

21.5.2 State diagram variables

Once set, variables retain their values as long as succeeding blocks contain no references to them.

Setting the parameter of a formal interface message assures that, on the next transmission of that message, the last parameter value set will be transmitted.

Testing the parameter of a formal interface messages tests the value of that message parameter that was received on the last transmission of said message. Message parameters may be assigned default values that persist until the first reception of the relevant message.

21.5.3 State transitions

The following terms are valid transition qualifiers:

a) Boolean expressions
b) An event such as the expiration of a timer: timer_done
c) An event such as the reception of a message: PMA_UNITDATA.indicate
d) An unconditional transition: UCT
e) A branch taken when other exit conditions are not satisfied: ELSE

Any open arrow (an arrow with no source block) represents a global transition. Global transitions are evaluated continuously whenever any state is evaluating its exit conditions. When a global transition becomes true, it supersedes all other transitions, including UCT, returning control to the block pointed to by the open arrow.

21.5.4 Operators

The state machine operators are shown in table 21-1.

Table 21-1—State machine operators

Character	Meaning
*	Boolean AND
+	Boolean OR
^	Boolean XOR
!	Boolean NOT
<	Less than
≤	Less than or equal to
=	Equals (a test of equality)
≠	Not equals
≥	Greater than or equal to
>	Greater than
( )	Indicates precedence
⇐	Assignment operator
∈	Indicates membership
∉	Indicates nonmembership
ELSE	No other state condition is satisfied

21.6 Protocol Implementation Conformance Statement (PICS) proforma

21.6.1 Introduction

The supplier of a protocol implementation that is claimed to conform to any part of the IEEE 802.3u 100BASE-T clauses 21 through 30 shall complete a Protocol Implementation Conformance Statement (PICS) proforma.

A completed PICS proforma is the PICS for the implementation in question. The PICS is a statement of which capabilities and options of the protocol have been implemented. A PICS is included at the end of each clause as appropriate. The PICS can be used for a variety of purposes by various parties, including the following:

a) As a checklist by the protocol implementor, to reduce the risk of failure to conform to the standard through oversight;
b) As a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma, by the supplier and acquirer, or potential acquirer, of the implementation;
c) As a basis for initially checking the possibility of interworking with another implementation by the user, or potential user, of the implementation (note that, while interworking can never be guaranteed, failure to interwork can often be predicted from incompatible PICS);
d) As the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation, by a protocol tester.

21.6.2 Abbreviations and special symbols

The following symbols are used in the PICS proforma:

M	mandatory field/function
O	optional field/function
O.<n>	optional field/function, but at least one of the group of options labeled by the same numeral <n> is required
O/<n>	optional field/function, but one and only one of the group of options labeled by the same numeral <n> is required
X	prohibited field/function
<item>:	simple-predicate condition, dependent on the support marked for <item>
<item1>*<item2>:	AND-predicate condition, the requirement must be met if both optional items are implemented

21.6.3 Instructions for completing the PICS proforma

The first part of the PICS proforma, Implementation Identification and Protocol Summary, is to be completed as indicated with the information necessary to identify fully both the supplier and the implementation.

The main part of the PICS proforma is a fixed-format questionnaire divided into subclauses, each containing a group of items. Answers to the questionnaire items are to be provided in the right-most column, either by simply marking an answer to indicate a restricted choice (usually Yes, No, or Not Applicable), or by entering a value or a set or range of values. (Note that there are some items where two or more choices from a set of possible answers can apply; all relevant choices are to be marked.)

Each item is identified by an item reference in the first column; the second column contains the question to be answered; the third column contains the reference or references to the material that specifies the item in the main body of the standard; the sixth column contains values and/or comments pertaining to the question

to be answered. The remaining columns record the status of the items—whether the support is mandatory, optional or conditional—and provide the space for the answers.

The supplier may also provide, or be required to provide, further information, categorized as either Additional Information or Exception Information. When present, each kind of further information is to be provided in a further subclause of items labeled A<i> or X<i>, respectively, for cross-referencing purposes, where <i> is any unambiguous identification for the item (e.g., simply a numeral); there are no other restrictions on its format or presentation.

A completed PICS proforma, including any Additional Information and Exception Information, is the Protocol Implementation Conformance Statement for the implementation in question.

Note that where an implementation is capable of being configured in more than one way, according to the items listed under Major Capabilities/Options, a single PICS may be able to describe all such configurations. However, the supplier has the choice of providing more than one PICS, each covering some subset of the implementation's configuration capabilities, if that would make presentation of the information easier and clearer.

21.6.4 Additional information

Items of Additional Information allow a supplier to provide further information intended to assist the interpretation of the PICS. It is not intended or expected that a large quantity will be supplied, and the PICS can be considered complete without any such information. Examples might be an outline of the ways in which a (single) implementation can be set up to operate in a variety of environments and configurations; or a brief rationale, based perhaps upon specific application needs, for the exclusion of features that, although optional, are nonetheless commonly present in implementations.

References to items of Additional Information may be entered next to any answer in the questionnaire, and may be included in items of Exception Information.

21.6.5 Exceptional information

It may occasionally happen that a supplier will wish to answer an item with mandatory or prohibited status (after any conditions have been applied) in a way that conflicts with the indicated requirement. No preprinted answer will be found in the Support column for this; instead, the supplier is required to write into the Support column an X<i> reference to an item of Exception Information, and to provide the appropriate rationale in the Exception item itself.

An implementation for which an Exception item is required in this way does not conform to this standard.

Note that a possible reason for the situation described above is that a defect in the standard has been reported, a correction for which is expected to change the requirement not met by the implementation.

21.6.6 Conditional items

The PICS proforma contains a number of conditional items. These are items for which both the applicability of the item itself, and its status if it does apply—mandatory, optional, or prohibited—are dependent upon whether or not certain other items are supported.

Individual conditional items are indicated by a conditional symbol of the form "<item>:<s>" in the Status column, where "<item>" is an item reference that appears in the first column of the table for some other item, and "<s>" is a status symbol, M (Mandatory), O (Optional), or X (Not Applicable).

If the item referred to by the conditional symbol is marked as supported, then 1) the conditional item is applicable, 2) its status is given by "<s>", and 3) the support column is to be completed in the usual way. Otherwise, the conditional item is not relevant and the Not Applicable (N/A) answer is to be marked.

Each item whose reference is used in a conditional symbol is indicated by an asterisk in the Item column.

21.7 Relation of 100BASE-T to other standards

Suitable entries for table G1 of ISO/IEC 11801: 1995, annex G, would be as follows:

a) Within the section Balanced Cable Link Class C (specified up to 16 MHz):
CSMA/CD 100BASE-T4 ISO/IEC 8802-3/DAD 1995 4
b) Within the section Optical Link:
CSMA/CD 100BASE-FX ISO/IEC 8802-3/DAD 1995 2
c) Within the section Balanced Cable Link Class D (Defined up to 100 MHz):
CSMA/CD 100BASE-TX ISO/IEC 8802-3/DAD 1995 2

NOTE—To support 100BASE-T4 applications, class C links shall have a NEXT value of at least 3 dB in excess of the values specified in 6.2.4.

Suitable entries for table G2 of ISO/IEC 11801: 1995, annex G, would be as follows:

	Balanced cabling per clauses 5, 7, and 8							**Performance based cabling per clause 6**												
								Class A			**Class B**			**Class C**			**Class D**		
	Cat 3 100 Ω	**Cat 4 100 Ω**	**Cat 5 100 Ω**	**Cat 3 120 Ω**	**Cat 4 120 Ω**	**Cat 5 120 Ω**	**150 Ω**	**100 Ω**	**120 Ω**	**150 Ω**	**100 Ω**	**120 Ω**	**150 Ω**	**100 Ω**	**120 Ω**	**150 Ω**	**100 Ω**	**120 Ω**	**150 Ω**
8802-3: 100BASE-T4	I*	I*	I*		I	I								I			I*	I	
8802-3: 100BASE-TX			I*				I*										I*		I*

* 8802-3 imposes additional requirements on propagation delay.

A suitable entry for table G3 of ISO/IEC 11801: 1995, annex G, would be as follows:

	Fibre per 5, 7, and 8			Optical link per clause 8								
				Horizontal			Building backbone			Campus backbone		
	62.5/125 μm MMF	50/125 μm MMF	10/125 μm MMF	62.5/125 μm MMF	50/125 μm MMF	10/125 μm MMF	62.5/125 μm MMF	50/125 μm MMF	10/125 μm MMF	62.5/125 μm MMF	50/125 μm MMF	10/125 μm MMF
8802-3: 100BASE-FX	N	I		N	I		N	I		N	I	

21.8 MAC delay constraints (exposed MII)

100BASE-T makes the following assumptions about MAC performance. These assumptions apply to any MAC with an exposed MII used with a 100BASE-T PHY.

Table 21-2—MAC delay assumptions (exposed MII)

Sublayer measurement points	Event	Min (bits)	Max (bits)	Input timing reference	Output timing reference
MAC ⇔ MII	MAC transmit start to TX_EN sampled		4		TX_CLK rising
	CRS assert to MAC detect	0	8		
	CRS de-assert to MAC detect	0	8		
	CRS assert to TX_EN sampled (worst case nondeferred transmit)		16		TX_CLK rising
	COL assert to MAC detect	0	8		
	COL de-assert to MAC detect	0	8		
	COL assert to TXD = Jam sampled (worst-case collision response)		16		TX_CLK rising; first nibble of jam

22. Reconciliation Sublayer (RS) and Media Independent Interface (MII)

22.1 Overview

This clause defines the logical, electrical, and mechanical characteristics for the Reconciliation Sublayer (RS) and Media Independent Interface (MII) between CSMA/CD media access controllers and various PHYs. Figure 22-1 shows the relationship of the Reconciliation sublayer and MII to the ISO (IEEE) OSI reference model.

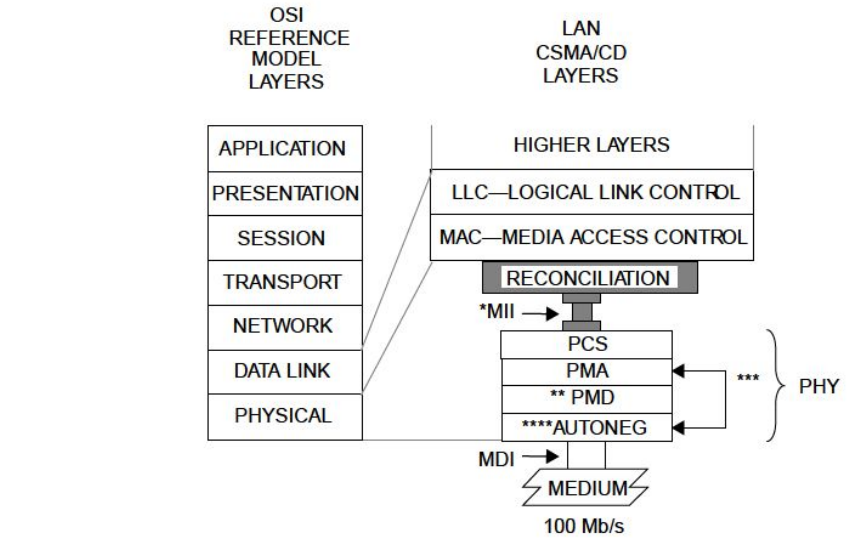


Figure 22-1—MII location in the protocol stack

The purpose of this interface is to provide a simple, inexpensive, and easy-to-implement interconnection between Media Access Control (MAC) sublayer and PHYs, and between PHYs and Station Management (STA) entities.

This interface has the following characteristics:

a) It is capable of supporting both 10 Mb/s and 100 Mb/s data rates.
b) Data and delimiters are synchronous to clock references.
c) It provides independent four bit wide transmit and receive data paths.
d) It uses TTL signal levels, compatible with common digital CMOS ASIC processes.
e) It provides a simple management interface.
f) It is capable of driving a limited length of shielded cable.