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

SECTION THREE: This section includes Clause 34 through Clause 43 and Annex 36A through Annex 43C.

34. Introduction to 1000 Mb/s baseband network

34.1 Overview

Gigabit Ethernet couples an extended version of the ISO/IEC 8802-3 (CSMA/CD MAC) to a family of 1000 Mb/s Physical Layers. The relationships among Gigabit Ethernet, the extended ISO/IEC 8802-3 (CSMA/CD MAC), and the ISO/IEC Open System Interconnection (OSI) reference model are shown in Figure 34–1.

Gigabit Ethernet uses the extended ISO/IEC 8802-3 MAC layer interface, connected through a Gigabit Media Independent Interface layer to Physical Layer entities (PHY sublayers) such as 1000BASE-LX, 1000BASE-SX, and 1000BASE-CX, and 1000BASE-T.

Gigabit Ethernet extends the ISO/IEC 8802-3 MAC beyond 100 Mb/s to 1000 Mb/s. The bit rate is faster, and the bit times are shorter—both in proportion to the change in bandwidth. In full duplex mode, the minimum packet transmission time has been reduced by a factor of ten. Achievable topologies for 1000 Mb/s full duplex operation are comparable to those found in 100BASE-T full duplex mode. In half duplex mode, the minimum packet transmission time has been reduced, but not by a factor of ten. Cable delay budgets are similar to those in 100BASE-T. The resulting achievable topologies for the half duplex 1000 Mb/s CSMA/CD MAC are similar to those found in half duplex 100BASE-T.

34.1.1 Reconciliation Sublayer (RS) and Gigabit Media Independent Interface (GMII)

The Gigabit Media Independent Interface (Clause 35) 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 GMII supports 1000 Mb/s operation through its eight bit wide (octet wide) transmit and receive paths. The Reconciliation sublayer provides a mapping between the signals provided at the GMII and the MAC/PLS service definition.

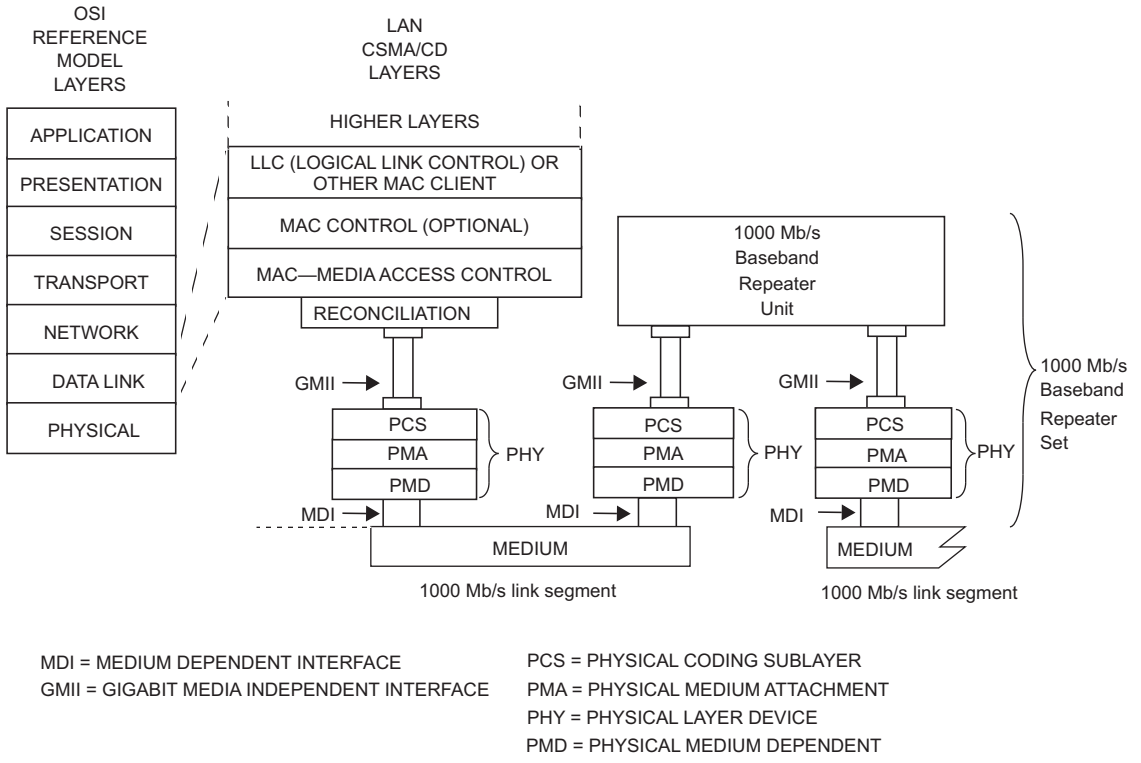

Figure 34–1—Architectural positioning of Gigabit Ethernet (1000 Mb/s operation)

34.1.2 Physical Layer signaling systems

This standard specifies a family of Physical Layer implementations. The generic term 1000 Mb/s MAC refers to any use of the 1000 Mb/s ISO/IEC 8802-3 CSMA/CD MAC (the Gigabit Ethernet MAC) coupled with any physical layer implementation.

The term 1000BASE-X refers to a specific family of physical layer implementations specified in Clause 36 through Clause 39. The 1000BASE-X family of physical layer standards has been adapted from the ANSI X3.230-1994 [B20] (Fibre Channel) FC-0 and FC-1 physical layer specifications and the associated 8B/10B data coding method. The 1000BASE-X family of physical layer implementations is composed of 1000BASE-SX, 1000BASE-LX, and 1000BASE-CX.

All 1000BASE-X PHY devices share the use of common PCS, PMA, and Auto-Negotiation specifications (see Clause 36 and Clause 37). The 1000BASE-T PHY (Clause 40) uses four pairs of balanced copper 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. Clause 40 defines its own PCS, which does not use 8B/10B coding.

Specifications unique to the physical operation of each physical layer device are shown in the following table:

1000BASE-SX Short Wave Length Optical	Duplex multimode fibers	Clause 38
1000BASE-LX Long Wave Length Optical	Duplex single-mode fibers or Duplex multimode fibers	Clause 38
1000BASE-CX Shielded Jumper Cable	Two pairs of specialized balanced cabling	Clause 39
1000BASE-T Category 5 UTP	Advanced multilevel signaling over four pairs of Category 5 balanced copper cabling.	Clause 40

34.1.3 Repeater

A repeater set (Clause 41) is an integral part of any Gigabit Ethernet network with more than two DTEs in a collision domain. A repeater set extends the physical system topology by coupling two or more segments. Only one repeater is permitted within a single collision domain.

34.1.4 Auto-Negotiation, type 1000BASE-X

Auto-Negotiation (Clause 37) provides a 1000BASE-X device with the capability to detect the abilities (modes of operation) supported by the device at the other end of a link segment, determine common abilities, and configure for joint operation. Auto-Negotiation is performed upon link startup through the use of a special sequence of reserved link codewords. Clause 37 adopts the basic architecture and algorithms from Clause 28, but not the use of fast link pulses.

34.1.5 Auto-Negotiation, type 1000BASE-T

Auto-Negotiation (Clause 28) is used by 1000BASE-T devices to detect the abilities (modes of operation) supported by the device at the other end of a link segment, determine common abilities, and configure for joint operation. Auto-Negotiation is performed upon link startup through the use of a special sequence of fast link pulses.

34.1.6 Management

Managed objects, attributes, and actions are defined for all Gigabit Ethernet components (Clause 30). That clause consolidates all IEEE 802.3 management specifications so that agents can be managed by existing network management stations with little or no modification to the agent code.

34.2 State diagrams

State machine diagrams take precedence over text.

The conventions of 1.2 are adopted, along with the extensions listed in 21.5.

34.3 Protocol implementation conformance statement (PICS) proforma

The supplier of a protocol implementation that is claimed to conform to any part of IEEE 802.3, Clause 35 through Clause 41, 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. Each of the Gigabit Ethernet PICS conforms to the same notation and conventions used in 100BASE-T (see 21.6).

34.4 Relation of Gigabit Ethernet to other standards

Supported applications for 10 Gigabit Ethernet can be found in ISO/IEC 11801: 2002, Annex F.

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

a) Within the section Optical Link:
CSMA/CD 1000BASE-SX ISO/IEC 8802-3/ PDAM 26
b) Within the section Optical Link:
CSMA/CD 1000BASE-LX ISO/IEC 8802-3/PDAM 26
c) Within the section Balanced Cabling Link Class D (defined up to 100 MHz):
CSMA/CD 1000BASE-T* ISO/IEC 8802-3/DAD 1995

*To support 1000BASE-T applications, Class D links shall meet the requirements for return loss, ELFEXT and MDELFEXT specified in 40.7.

A suitable entry for Table G5 of ISO/IEC 11801: 1995, Annex G, would be as follows:

Table 34–1—Table G5 of ISO/IEC 11801

	Fibre			**Optical link per 6**								
	per Clauses 5, 7, and 8			**Horizontal**			**Building backbone**			**Campus backbone**		
	62.5/ 125 μm MMF	**50/ 125 μm MMF**	**10/ 125 μm SMF**	**62.5 /125 μm MMF**	**50/ 125 μm MMF**	**10/ 125 μm SMF**	**62.5 /125 μm MMF**	**50/ 125 μm MMF**	**10/ 125 μm SMF**	**62.5 /125 μm MMF**	**50/ 125 μm MMF**	**10/ 125 μm SMF**
8802-3: 1000BASE-SX	I	I		N	N		I	N		I	I	
8802-3: 1000BASE-LX	I	I	I	N	N	N	N	N	N	I	I	N
NOTE—"N" denotes normative support of the media in the standard. "I" denotes that there is information in the International Standard regarding operation on this media.												

Suitable entries for table G4 of ISO/IEC 11801:1995 Annex G would be:

Table 34–2—Table G4 of ISO/IEC 11801:1995

	Balanced cabling							**Performance based cabling per 6**											
	per Clauses 5, 7, and 8							**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: 1000BASE-T			I[a]														I[a]		
NOTE—"I" denotes that there is information in the International Standard regarding operation on this media.																			

[a]8802-3 imposes additional requirements on return loss, ELFEXT and MDELFEXT.