

**System Considerations for
Multisegment 10 Mb/s
Baseband Networks
(Section 13)**

**Twisted-Pair Medium
Attachment Unit (MAU)
and Baseband Medium,
Type 10BASE-T
(Section 14)**



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**

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(MAU) and Baseband Medium, Type
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Published by
The Institute of Electrical and Electronics Engineers, Inc.

Abstract: This Local Area Network (LAN) standard, IEEE Std 802.3i-1990 (supplement to ISO/IEC 8802-3:1990 [ANSI/IEEE Std 802.3-1990 Edition]), specifies the Type 10BASE-T Medium Attachment Unit (MAU) and one specific unshielded twisted-pair medium for use with the MAU. This MAU is specified for use in a 10 Mb/s baseband CSMA/CD LAN. Guidelines for its application in a repeated multisegment heterogeneous CSMA/CD network are included.

ISBN 1-55937-070-X

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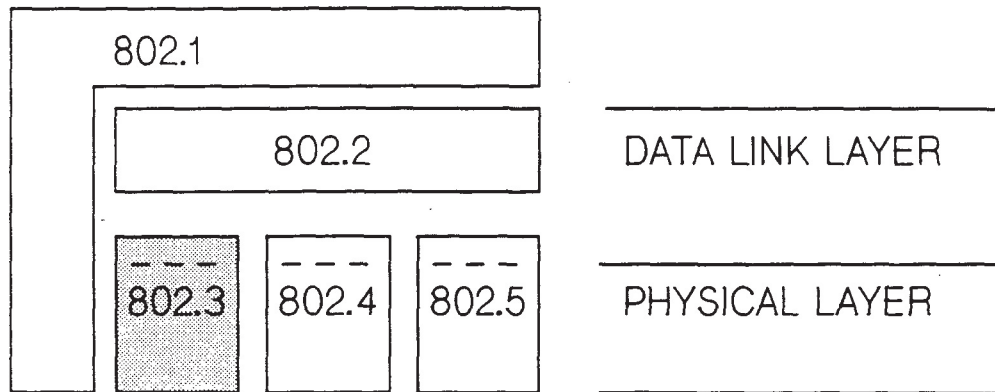
December 31, 1990

SH13763

Foreword

(This Foreword is not a part of IEEE Std 802.3i-1990.)

This supplement is part of a family of standards for Local and Metropolitan Area Networks. The relationship between this standard and other members of the family is shown below. (The numbers in the figure refer to IEEE standard numbers.)



This family of standards deals with the Physical and Data Link Layers as defined by the ISO Open Systems Interconnection Basic Reference Model (ISO 7498:1984). The access standards define three types of medium access technologies and associated physical media, each appropriate for particular applications or system objectives. The standards defining these technologies are as follows:

- (1) ISO/IEC 8802-3 [ANSI/IEEE Std 802.3-1990 Edition], a bus utilizing CSMA/CD as the access method;
- (2) ISO/IEC 8802-4 [ANSI/IEEE Std 802.4-1990], a bus utilizing token-passing as the access method;
- (3) ANSI/IEEE Std 802.5-1989, a ring utilizing token-passing as the access method.

Other access methods (for example, metropolitan area networks and integrated voice-data networks) are under investigation.

ISO 8802-2 [ANSI/IEEE Std 802.2-1989], the logical link control (LLC) standard, is used in conjunction with the medium access standards.

IEEE Std 802-1990* describes the relationship among the family of 802 standards and their relationship to the ISO Open Systems Interconnection Basic Reference Model in more detail. IEEE Std 802.1D-1990 deals with media ac-

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

cess control (MAC) bridging and IEEE Std 802.1E-1990 specifies a protocol for loading end systems (both to be published in early 1991). Other projects in the 802.1 series are currently under development.

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

The local area network access mechanism specified by this standard may include patented matter. The IEEE Standards Office calls attention to the fact that it is claimed that the process of the local area network access mechanism described throughout this standard is the subject of United States patent numbers 4 063 220 and 4 099 024 and corresponding patents of foreign countries owned by the Xerox Corporation. Although these patents appear to cover the access mechanism subject in this standard, the IEEE takes no position with respect to patent validity. The Xerox Corporation has assured the IEEE that it is willing to grant a license under these patents on reasonable and nondiscriminatory terms and conditions to anyone wishing to obtain such a license. The Xerox Corporation's undertakings in this respect are on file with the IEEE Standards Office and the license details may be obtained from the Office of General Counsel of Xerox Corporation, whose address is Post Office Box 1600, Stamford, Connecticut 06904, USA.

This standard contains state-of-the-art material. The area covered by this standard is undergoing evolution. Revisions are anticipated to this standard within the next few years to clarify existing material, to correct possible errors, and to incorporate new related material.

Readers wishing to know the state of revisions should contact
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10BASE-T (Section 14)**

Revisions to ISO/IEC 8802-3:1990 [ANSI/IEEE Std 802.3-1990 Edition]

(These changes and additions are part of IEEE Std 802.3i-1990.)

The following changes add references to 10BASE-T and specifications for 10BASE-T to the appropriate places in ISO/IEC 8802-3:1990 [ANSI/IEEE Std 802.3-1990 Edition]. The changes do not alter the specifications for existing systems.

1.3 References

Add this reference to list of references:

[16] ISO 8877:1987, Information processing systems—Interface connector and contact assignments for ISDN basic access interface located at reference points S and T.

4.4.2.1 Parameterized Values

In first sentence, delete “(type 10BASE5)”.

8.6.1 Transmission System Model

Replace current item (2) with the following:

“(2) A point-to-point link constitutes a link segment. A link segment may contain a maximum end-to-end propagation delay of 2570 ns.”

9.1 Overview

In the first sentence, change “10BASE5 and 10BASE2” to “10BASE5, 10BASE2, and 10BASE-T”.

Change the second paragraph to read as follows:

“A repeater set connects segments of network medium together, thus allowing larger topologies and a larger MAU base than are allowed by rules governing individual segments (that is, for 10BASE5, 500 m and 100 stations; for 10BASE2, 185 m and 30 stations; for 10BASE-T, nominal 100 m link segment).”

At the end of the third paragraph, replace “IRLs” with “link segments”.

9.2 Definitions

Add the following definition:

“link segment. The point-to-point full duplex medium connection between two and only two Medium-Dependent Interfaces (MDIs).”

9.4.1 AUI Compatibility

Add this paragraph to the end of 9.4.1:

“MAUs associated with the repeater unit shall be as specified in Section 14 for type 10BASE-T with the restriction that the MAU shall not perform the *signal_quality_error* message Test function as defined in 14.2.1.5.”

9.4.2 Direct Cable Compatibility

Change title of subsection to read as follows:

“Direct Coax Cable Compatibility”

9.4.3 IRL Compatibility

Change entire subsection, including title, to read as follows:

“9.4.3 Link Segment Compatibility. The compatibility interfaces for link segments including IRL segments are either vendor-dependent, as specified in 9.4.3.1, or are vendor-independent MDI, as defined in the remainder of this section.”

Add the following subsection:

“9.4.3.3 Twisted-Pair Jack Compatibility. The repeater set shall be compatible at its 8-pin modular jack (if so equipped), as specified in 14.5. The MAUs associated with the repeater set that are connected in this manner shall be subject to the restrictions of MAUs, as specified in 9.4.1.”

9.5.2 Signal Amplification

Change the first sentence to read:

“The repeater set (including its associated or integral MAUs) shall ensure that the amplitude characteristics of the signals at the MDI outputs of the repeater set are within the tolerance of the specification for the appropriate MAU type.”

9.5.3 Signal Symmetry

Change entire subsection to read as follows:

“The repeater set shall ensure that the symmetry characteristics of the signals at the MDI outputs of a repeater set are within the tolerance of the specification for the appropriate MAU type. Therefore, any loss of symmetry due to MAUs and media distortion is regained at the output of the repeater set.”

9.5.5.1 Start of Packet Propagation Delays

In third paragraph, change “internal MAUs” to “internal FOMAU, 10BASE2, or 10BASE5 MAUs”.

Add this paragraph following the third paragraph:

“For a repeater set with internal 10BASE-T MAUs on input and output ports, an additional 8 BT delay for an input port MAU and 5 BT delay for an output port MAU shall be allowed.”

9.5.6.3 Collision-Jam Propagation Delays

In third paragraph, change “internal MAUs” to “internal FOMAU, 10BASE2, or 10BASE5 MAUs”.

Add this paragraph following the third paragraph:

“For a repeater set with internal 10BASE-T MAUs on input and output ports, an additional 9 BT delay for an input port MAU and 5 BT delay for an output port MAU shall be allowed.”

In the sixth paragraph, change “internal MAUs” to “internal FOMAU, 10BASE2, and 10BASE5 MAUs” in two instances.

Add this paragraph following the sixth paragraph:

“For a repeater set with internal 10BASE-T MAUs on its input ports, an additional 2 BT delay for DI and 9 BT for *signal_quality_error* deassertion shall be allowed. For a repeater set with internal MAUs on its output ports, an additional 2 BT delay shall be allowed.”

9.6.6.2 Detailed Auto-Partition/Reconnection Algorithm State Diagram

Add the following as the first sentence of the first paragraph:

“Repeater sets with 10BASE-T MAUs shall implement an auto-partition/reconnection algorithm on those ports.”

9.7.1 Environment A Requirements

In the second paragraph, change “(See 8.3.2.1 and 10.4.2.1.)” to “(See 8.3.2.1, 10.4.2.1, and 14.3.1.1.)”.

9.9.1.1 Overview

Change (d) and (e) to read as follows:

- “(d) Operates indistinguishably from a repeater set MAU, as defined in Section 8, 10, or 14 when viewed from the AU Interface.
- (e) Supports 10BASE2, 10BASE5, and 10BASE-T system configurations as defined in Sections 8, 10, and 13 of this standard.”

Appendix A3

Add this paragraph to the end of Appendix A3 (in the collection of supplements to 802.3: IEEE Std 802.3b, c, d, and e-1989 Edition):

“The calculation method of this Appendix, though not the numeric values, applies to 10BASE-T.”

13. System Considerations for Multisegment 10 Mb/s Baseband Networks

13.1 Overview. This section provides information on building multisegment 10 Mb/s 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 4.4.2.1, and the number of repeaters between any two Data Terminal Equipments (DTEs) to be limited in order to limit the shrinkage of the interpacket gap as it travels through the network. This section applies to networks that contain 10BASE-T segments.

NOTE: Information on 10BASE-T is included to begin the process of developing this section. It is intended that 8.6.1 and 10.7.1 be merged into this section in the future and that any new 10BASE segments be added to this section.

13.2 Definitions. Terminology used in Section 13, and not previously defined, is defined here:

collision domain. A single CSMA/CD network. If two or more Media Access Control (MAC) sublayers are within the same collision domain and both transmit at the same time, a collision will occur. MAC sublayers separated by a repeater are within the same collision domain. MAC sublayers separated by a bridge are within different collision domains.

link segment. The point-to-point full duplex medium connection between two and only two Medium-Dependent Interfaces (MDIs).

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

13.3 Transmission System Model. The physical size of a 10BASE-T network, or mixed-media network containing 10BASE-T link segments, is constrained by the limits of individual network components. These limits include the following:

- (1) Cable length and its associated propagation time delay.
- (2) Delay of repeater units (start-up and steady-state).
- (3) Delay of MAUs (start-up and steady-state).
- (4) Interpacket gap shrinkage.
- (5) Delays within the DTE associated with the CSMA/CD access method.

The following table summarizes the delays for the various network media segments:

Media Segment Type	Maximum Number of MAUs per Segment	Maximum Segment Length (m)	Minimum Medium Propagation Velocity*	Maximum Medium Delay per Segment (ns)
Coax				
10BASE5	100	500	0.77 c	2165
10BASE2	30	185	0.65 c	950
Link				
FOIRL	2	1000	0.66 c	5000
10BASE-T	2	100 [†]	0.59 c	1000
AUI [‡]	1 DTE/1 MAU	50	0.65 c	257

* $c = 3 \times 10^8$ m/s

[†] Actual maximum segment length depends on cable characteristics; see 14.1.1.3.

[‡] AUI is not a segment.

In addition, Table 14-1 summarizes the delays for the 10BASE-T MAU; Section 8, the delays for the 10BASE5 MAU; Section 10, the delays for the 10BASE2 MAU; and Section 9, the delays of the fiber optic inter-repeater link (FOIRL) and the repeater.

The following network topology constraints apply for 10BASE-T networks as well as mixed-media networks containing 10BASE-T link segments:

- (1) Repeater sets are required for all segment interconnection.
- (2) MAUs that are part of repeater sets count toward the maximum number of MAUs on a segment.
- (3) The transmission path permitted between any two DTEs may consist of up to five segments, four repeater sets (including optional AUIs), two MAUs, and two AUIs.
- (4) When a network path consists of four repeater sets and five segments, up to three of the segments may be coax and the remainder must be link segments (Figs 13-1 and 13-2). When five segments are present, each FOIRL link segment should not exceed 500 m.
- (5) When a network path consists of three repeater sets and four segments, the maximum allowable length of the FOIRL segments is 1000 m each, as specified in 9.9 (Fig 13-3).

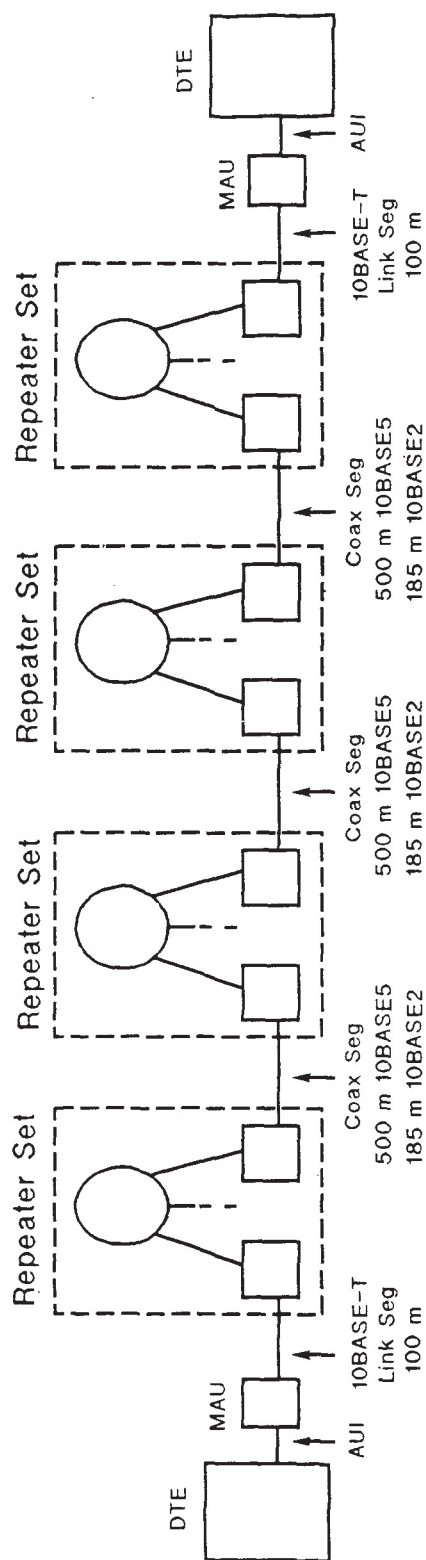


Fig 13-1
Maximum Transmission Path with Three Coax Segments

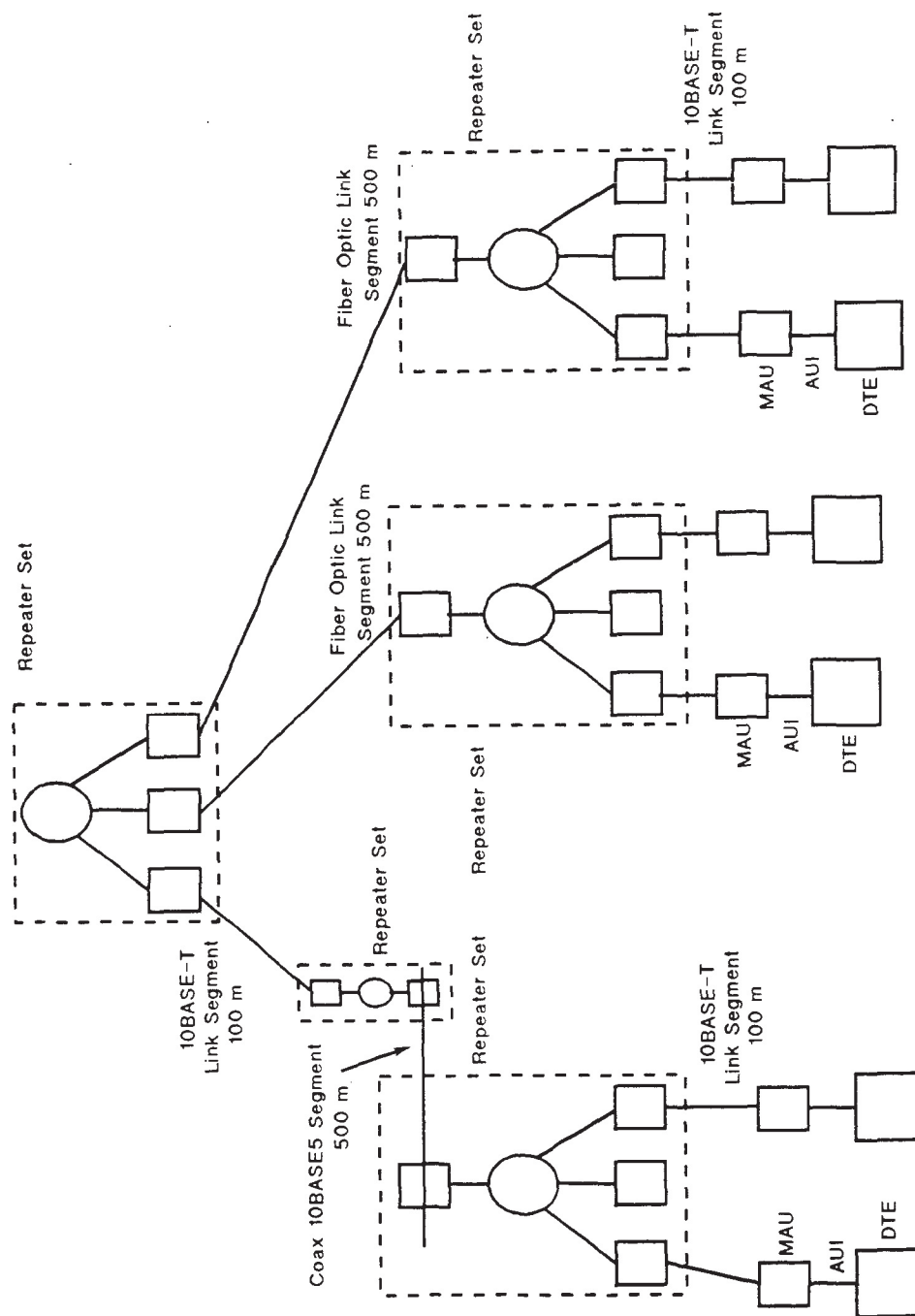


Fig 13-2
Example of Maximum Transmission Path Using Coax Segments,
10BASE-T Link Segments, and Fiber Optic Link Segments