INTERNATIONAL STANDARD

ISO/IEC 8802-5

ANSI/IEEE Std 802.5

Third edition
1998-09-15

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

Part 5: Token ring access method and physical layer specifications

Technologies de l'information — Télécommunications et échange d'information entre systèmes — Réseaux locaux et urbains — Exigences spécifiques —

Partie 5: Méthode d'accès par anneau à jeton et spécifications pour la couche physique

Reference number
ISO/IEC 8802-5:1998(E)
ANSI/IEEE
Std 802.5, 1998 edition

Abstract: This Local and Metropolitan Area Network standard, ISO/IEC 8802-5 : 1998, is part of a family of local area network (LAN) standards dealing with the physical and data link layers as defined by the ISO/IEC Open Systems Interconnection Basic Reference Model. Its purpose is to provide compatible interconnection of data processing equipment by means of a LAN using the token-passing ring access method. The frame format, including delimiters, addressing, and priority stacks, is defined. The medium access control (MAC) protocol is defined. The finite state machine and state tables are supplemented with a prose description of the algorithms. The physical layer (PHY) functions of symbol encoding and decoding, symbol time, and latency buffering are defined. The services provided by the MAC to the station management (SMT) and the services provided by the PHY to SMT and the MAC are described. These services are defined in terms of service primitives and associated parameters. The 4 and 16 Mbit/s, shielded twisted pair attachment of the station to the medium, including the medium interface connector (MIC), is also defined. The applications environment for the LAN is intended to be commercial and light industrial. The use of token ring LANs in home and heavy industrial environments, while not precluded, has not been considered in the development of the standard. A Protocol Implementation Conformance Statement (PICS) proforma is provided as an annex to the standard.
Keywords: data processing interconnection, local area network (LAN), medium access control (MAC), token ring

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ISO/IEC 8802-5 : 1998
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Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—

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International Standard ISO/IEC 8802-5:1998(E)

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In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 8802-5 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

This third edition cancels and replaces the second edition (ISO/IEC 8802-5:1995), which has been technically revised.

ISO/IEC 8802 consists of the following parts, under the general title *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements*:

— *Part 1: Overview of Local Area Network Standards*

— *Part 2: Logical link control*

— *Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

— *Part 4: Token-passing bus access method and physical layer specifications*

— *Part 5: Token ring access method and physical layer specifications*

— *Part 6: Distributed Queue Dual Bus (DQDB) access method and physical layer specifications*

— *Part 9: Integrated Services (IS) LAN Interface at the Medium Access Control (MAC) and Physical (PHY) Layers*

— *Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications*

— *Part 12: Demand-priority access method, physical layer and repeater specifications*

Annexes A and B form an integral part of this part of ISO/IEC 8802. Annexes C to J and P are for information only.

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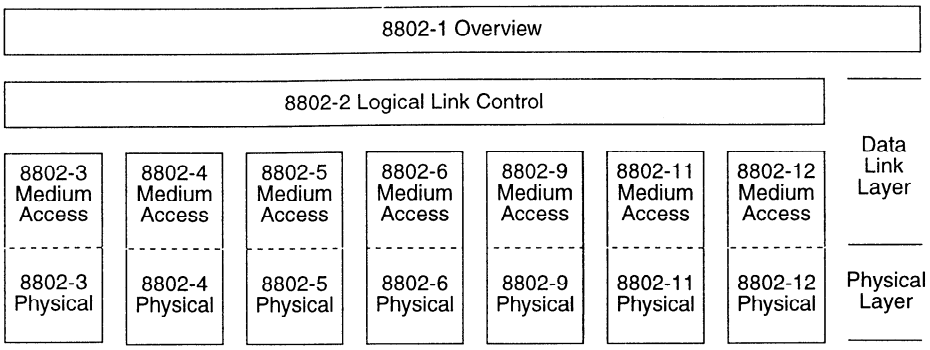
Foreword to International Standard ISO/IEC 8802-5 : 1998

This International Standard is part of a family of International Standards for Local and Metropolitan Area Networks. The relationship between this International Standard and the other members of the family is shown below. (The numbers in the figure refer to ISO/IEC Standard numbers.)



This family of International Standards deals with the Physical and Data Link layers as defined by the ISO Open Systems Interconnection (OSI) Basic Reference Model (ISO/IEC 7498-1: 1994). The access standards define seven types of medium access technologies and associated physical media, each appropriate for particular applications or system objectives. Other types are under investigation.

The International Standards defining the access technologies are as follows:

a) ISO/IEC 8802-3, utilizing carrier sense multiple access with collision detection (CSMA/CD) as the access method.
b) ISO/IEC 8802-4, utilizing token passing bus as the access method.
c) ISO/IEC 8802-5, utilizing token passing ring as the access method.
d) ISO/IEC 8802-6, utilizing distributed queuing dual bus as the access method.
e) ISO/IEC 8802-9, a unified access method offering integrated services for backbone networks.
f) ISO/IEC DIS 8802-11, a wireless LAN utilizing carrier sense multiple access with collision avoidance (CSMA/CA) as the access method.
g) ISO/IEC DIS 8802-12, utilizing Demand Priority as the access method.

ISO/IEC TR 8802-1, *Overview of Local Area Network Standards,* provides an overview of the series of ISO/IEC 8802 standards.

ISO/IEC 8802-2, *Logical Link Control*, is used in conjunction with the medium access standards to provide the data link layer service to network layer protocols.

ISO/IEC 15802-1, *Medium Access Control (MAC) service definition,* specifies the characteristics of the common MAC Service provided by all IEEE 802 LAN MACs. The service is defined in terms of primitives that can be passed between peer service users, their parameters, their interrelationship and valid sequences, and the associated events of the service.

ISO/IEC 15802-2, *LAN/MAN Management*, defines an OSI management-compatible architecture, and services and protocol elements for use in a LAN/MAN environment for performing remote management.

ISO/IEC 10038, *Media Access Control (MAC) bridges*, specifies an architecture and protocol for the interconnection of IEEE 802 LANs below the level of the logical link control protocol (to be renumbered 15802-3).

ISO/IEC 15802-4, *System Load Protocol*, specifies a set of services and protocol for those aspects of management concerned with the loading of systems on IEEE 802 LANs.

ISO/IEC 15802-5, *Remote Media Access Control (MAC) bridging*, specifies extensions for the interconnection, using non-LAN communication technologies, of geographically separated IEEE 802 LANs below the

ANSI/IEEE Std 802.5, 1998 Edition

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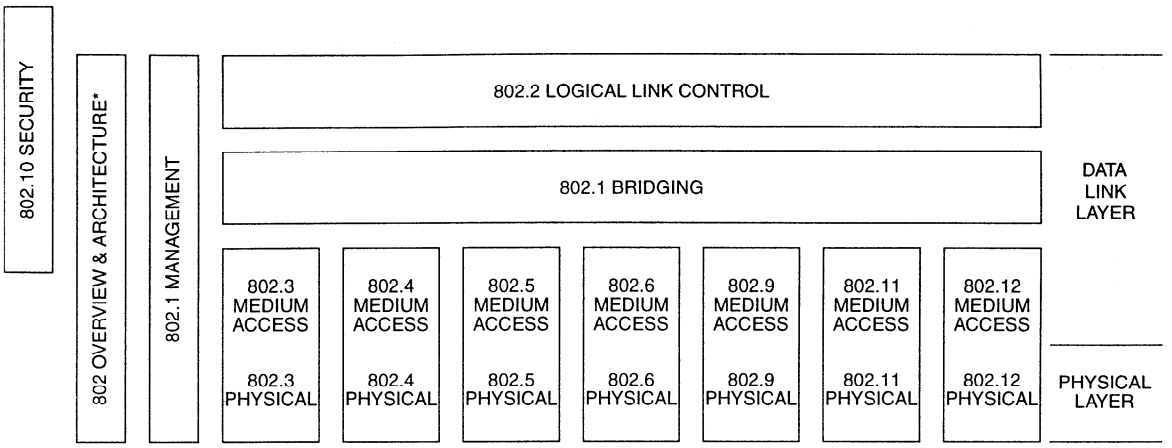
Note: Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. The IEEE shall not be responsible for identifying patents for which a license may be required by an IEEE standard or for conducting inquiries into the legal validity or scope of those patents that are brought to its attention.

Introduction to ANSI/IEEE Std 802.5, 1998 Edition

(This introduction is not a part of ANSI/IEEE Std 802.5, 1998 Edition or of ISO/IEC 8802-5 : 1998.)

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



* Formerly IEEE Std 802.1A.

This family of standards deals with the Physical and Data Link layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) Basic Reference Model (ISO/IEC 7498-1 : 1994). The access standards define seven types of medium access technologies and associated physical media, each appropriate for particular applications or system objectives. Other types are under investigation.

The standards defining the technologies noted above are as follows:

- IEEE Std 802 — *Overview and Architecture.* This standard provides an overview to the family of IEEE 802 Standards.
- ANSI/IEEE Std 802.1B and 802.1k [ISO/IEC 15802-2] — *LAN/MAN Management.* Defines an OSI management-compatible architecture, and services and protocol elements for use in a LAN/MAN environment for performing remote management.
- ANSI/IEEE Std 802.1D [ISO/IEC 10038] — *Media Access Control (MAC) Bridges.* Specifies an architecture and protocol for the interconnection of IEEE 802 LANs below the MAC service boundary.
- ANSI/IEEE Std 802.1E [ISO/IEC 15802-4] — *System Load Protocol.* Specifies a set of services and protocol for those aspects of management concerned with the loading of systems on IEEE 802 LANs.
- ANSI/IEEE Std 802.1G [ISO/IEC 15802-5] — *Remote Media Access Control (MAC) Bridging.* Specifies extensions for the interconnection, using non-LAN communication technologies, of geographically separated IEEE 802 LANs below the level of the logical link control protocol.
- ANSI/IEEE Std 802.2 [ISO/IEC 8802-2] — *Logical Link Control*
- ANSI/IEEE Std 802.3 [ISO/IEC 8802-3] — *CSMA/CD Access Method and Physical Layer Specifications*

- ANSI/IEEE Std 802.4 [ISO/IEC 8802-4] — *Token Passing Bus Access Method and Physical Layer Specifications*
- ANSI/IEEE Std 802.5 [ISO/IEC 8802-5] — *Token Ring Access Method and Physical Layer Specifications*
- ANSI/IEEE Std 802.6 [ISO/IEC 8802-6] — *Distributed Queue Dual Bus Access Method and Physical Layer Specifications*
- ANSI/IEEE Std 802.9 [ISO/IEC 8802-9] — *Integrated Services (IS) LAN Interface at the Medium Access Control (MAC) and Physical (PHY) Layers*
- ANSI/IEEE Std 802.10 — *Interoperable LAN/MAN Security*
- IEEE Std 802.11 [ISO/IEC DIS 8802-11] — *Wireless LAN Medium Access Control (MAC) and Physical Layer Specifications*
- ANSI/IEEE Std 802.12 [ISO/IEC DIS 8802-12] — *Demand Priority Access Method, Physical Layer and Repeater Specifications*

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

- IEEE Std 802.7 — *IEEE Recommended Practice for Broadband Local Area Networks*

The following additional working group has authorized standards projects under development:

- IEEE 802.14 — *Standard Protocol for Cable-TV Based Broadband Communication Network*

Conformance test methodology

An additional standards series, identified by the number 1802, has been established to identify the conformance test methodology documents for the 802 family of standards. Thus the conformance test documents for 802.3 are numbered 1802.3.

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This standard specifies that each octet of the information field shall be transmitted most significant bit (MSB) first. This convention is reversed from that used in the CSMA/CD and Token Bus standards, which are least significant bit (LSB) first transmission. While the transmission of MSB first is used for token ring, this does not imply that MSB transmission is preferable.

The IEEE 802.5 Working Group maintains a web site including notices to implementors and up-to-date information, at **http://stdsbbs.ieee.org/groups/802/5/**.

Participants

Voting members of the IEEE 802.5 Working Group who participated in developing this Third Edition of the standard were as follows:

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Martin Guthrie	Roger Pandanda	David W. Wilson
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*Deceased

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Alan H. Cookson

Kristin Dittmann
IEEE Standards Project Editor

ISO/IEC 8802-5 : 1998 [ANSI/IEEE Std 802.5, 1998 Edition] was approved by the American National Standards Institute (ANSI) on 15 April 1998.

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Part 5: Token ring access method and physical layer specifications

1. Overview

1.1 Scope

For the purpose of compatible interconnection of data processing equipment via a local area network (LAN) using the token ring access method, this part of ISO/IEC 8802

a) Provides a general description of the token ring local area network (LAN) architecture (clause 2);

b) Defines the frame format, including the delimiters, address fields, information field, and frame-check sequence (FCS). Defines the Medium Access Control (MAC) frames, timers, and error counters (clause 3);

c) Defines the MAC protocols including finite state machines and state tables (clause 4);

d) Defines the system level Physical layer (PHY) signaling specifications that are specific to a ring station (clause 5);

e) Defines the managed objects necessary to manage the service and protocol elements that are involved in the management of a token ring station (clause 6);

f) Defines the PHY station attachment specification for 4 and 16 Mbit/s operation. This includes the transmitter, receiver, medium interface connector, and transmission channel for both shielded twisted pair (STP) and unshielded twisted pair (UTP) media (clause 7);

g) Defines the concentrator, incorporating multiple trunk coupling units (TCUs), for the attachment of a group of stations to the ring (clause 8);

h) Includes the protocol implementation conformance statement (PICS) proforma in compliance with the relevant requirements, and in accordance with the relevant guidance, given in ISO/IEC 9646-2 : 1994[1] (annex A);

i) Includes channel design examples and formulas for calculating cabling and concentrator system configurations (annex B);

j) Describes jitter components and provides an example of jitter buildup using a phase lock loop recovery circuit (annex C);

k) Provides informative transmitter filter design example (annex D);

l) Provides recommended guidelines for safety and operating environments (annex E);

m) Illustrates the MAC finite state machines in a notation similar to that used in ISO/IEC 8802-5 : 1992 (annex F);

n) Describes major improvements made after the first edition of the standard (annex G);

o) Provides a sample algorithm for the parsing of MAC frames (annex H);

p) Provides recommendations for the use of token ring access priorities to support multimedia traffic (annex I);

q) Provides bit error rate (BER) criteria for lobe media testing (annex P).

A particular emphasis of this standard is to specify the externally visible characteristics needed for interconnection compatibility, while avoiding unnecessary constraints upon and changes to internal design and implementation of the heterogeneous processing equipment to be interconnected.

The applications environment for the LAN is intended to be commercial and light industrial. The use of token ring LANs in home and heavy industrial environments, while not precluded, has not been considered in the development of this standard.

This standard, the Third Edition of this part of ISO/IEC 8802, provides enhancements and corrections to the Second Edition. The Second Edition provided greater specificity and improved clarity to the First Edition (1992-06-12) to ensure interoperability of the various components in the token ring network. The intent of this edition is to maintain interoperability with stations designed to this specification and stations designed to prior editions of the standard. However, interoperability with prior implementations (particularly in regard to clause 7) cannot be guaranteed due to nonspecificity within the 1992 edition. Annex G lists the specific differences between the second edition and the first edition.

The following items are subjects for future study:

a) Controlled bit altering by any device except a station.

b) Methodology to assure handling of joining of multiple rings as may be used by managed concentrators to assure normal insertion process protection mechanisms (such as duplicate address test or ring parameter server notification).

c) Ring data rate determination to allow managed data rate adaptation between stations.

d) Alternative active concentrators or repeaters that provide increased cabling distances and/or enhanced operation of rings containing devices built to the first edition of this standard, ISO/IEC 8802-5 : 1992.

e) Converters that allow the interconnection of stations on different media types.

f) Methodologies to provide enhanced transmission reliability over the trunk cable.

[1] Information on references can be found in 1.2.

g) Definition of concentrator managed objects.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 8802. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on ISO/IEC 8802-5 : 1998 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of ISO and IEC maintain registers of currently valid International Standards.

CISPR Publication 22 : 1985, Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment.[2]

IEC 6073 : 1996, Basic and safety principles for man-machine interface, marking and identification—Coding principles for indicating devices and actuators.[3]

IEC 60603-7 : 1996, Connectors for frequencies below 3 MHz for use with printed boards—Part 7: Detail specification for connectors, 8-way, including fixed and free connectors with common mating features, with assessed quality.

IEC 60950 : 1991, Safety of information technology equipment.

ISO/IEC 7498-1 : 1994, Information technology—Open Systems Interconnection—Basic Reference Model: The Basic Model.[4]

ISO/IEC 7498-4 : 1989, Information processing systems—Open Systems Interconnection—Basic Reference Model—Part 4: Management framework.

ISO/IEC 8802-2 : 1994 [ANSI/IEEE Std 802.2, 1994 Edition], Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 2: Logical link control.[5]

ISO/IEC 8824 : 1990, Information technology—Open Systems Interconnection—Specification of Abstract Syntax Notation One (ASN.1).

ISO/IEC 9646-1 : 1994, Information technology—Open Systems Interconnection—Conformance testing methodology and framework—Part 1: General concepts.

ISO/IEC 9646-2 : 1994, Information technology—Open Systems Interconnection—Conformance testing methodology and framework—Part 2: Abstract Test Suite specification.

ISO/IEC 10038 : 1993 [ANSI/IEEE Std 802.1D, 1993 Edition], Information technology—Telecommunication and information exchange between systems—Local area networks—Media access control (MAC) bridges.

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[2]CISPR and IEC publications are available from the International Electrotechnical Commission, 3, rue de Varembé, Case Postale 131, CH-1211, Genève 20, Switzerland/Suisse. These publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

[3]See footnote 2.

[4]ISO/IEC [illegible] are available from ISO, Case Postale 56, 1, rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse. These publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

[5]ISO/IEC [ANSI/IEEE] are available from ISO. They are also available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.