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IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee



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IEEE Computer Society

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Abstract: IEEE Std 802-2001, IEEE Standards for Local and Metropolitan Area Networks: Overview and Architecture, provides an overview to the family of IEEE 802 Standards. It defines compliance with the family of IEEE 802 Standards; it describes the relationship of the IEEE 802 Standards to the Open Systems Interconnection Basic Reference Model [ISO/IEC 7498-1:1994] and explains the relationship of these standards to the higher layer protocols; it provides a standard for the structure of LAN MAC addresses; and it provides a standard for identification of public, private, and standard protocols.

Keywords: IEEE 802 standards compliance, Local Area Networks (LANs), LAN/MAN architecture, LAN/MAN reference model, Metropolitan Area Networks (MANs).

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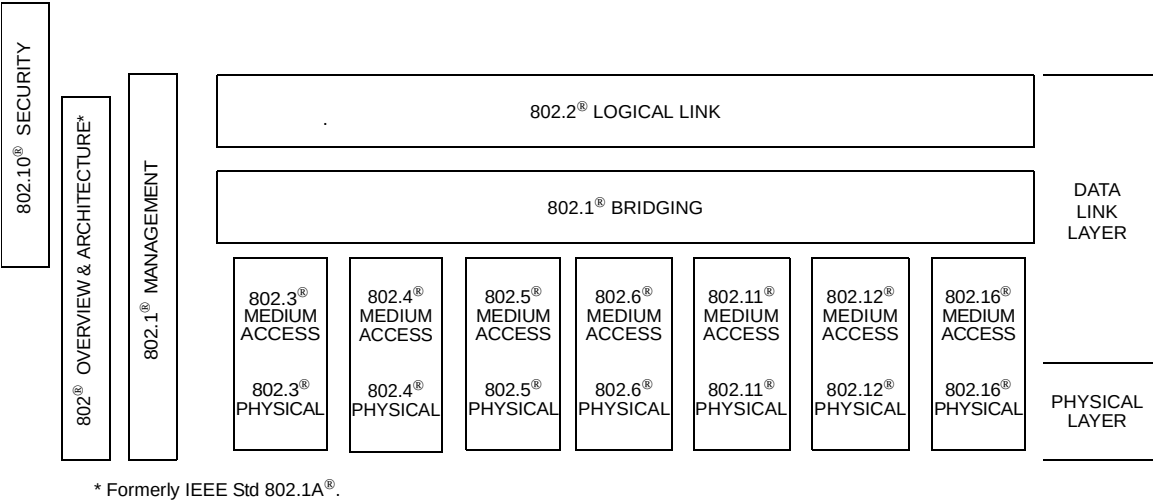
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Introduction

(This introduction is not part of IEEE Std 802-2001[®], IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture.)

IEEE Std 802-2001[®] provides an overview to the family of IEEE 802[®] Standards. It defines compliance with the family of IEEE 802[®] Standards; it describes the relationship of the IEEE 802[®] Standards to the Open Systems Interconnection Basic Reference Model [ISO/IEC 7498-1: 1994] and explains the relationship of these standards to higher layer protocols; it provides a standard for the structure of LAN MAC addresses; and it provides a standard for the identification of public, private, and standard protocols.

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.)



This family of standards deals with the Physical and Data Link Layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection Basic Reference Model (ISO/IEC 7498-1:1994). The access standards define several 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[®]:¹
Overview and Architecture. This standard provides an overview to the family of IEEE 802[®] Standards. This document forms part of the IEEE Std 802.1[®] scope of work.
- IEEE Std 802.1B[®]
and 802.1K[®]
[ISO/IEC 15802-2]:
LAN/MAN Management. Defines an Open Systems Interconnection (OSI) management-compatible architecture, and services and protocol elements for use in a LAN/MAN environment for performing remote management.

¹The IEEE 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[®].

- IEEE Std 802.1D[®] *Media Access Control (MAC) Bridges.* Specifies an architecture and protocol for the [ISO/IEC 15802-3]: interconnection of IEEE 802[®] LANs below the MAC service boundary.

- 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.

- IEEE Std 802.1F[®] *Common Definitions and Procedures for IEEE 802[®] Management Information.*

- IEEE Std 802.1G[®] [ISO/IEC 15802-5]: *Remote Media Access Control (MAC) Bridging.* Specifies extensions for the interconnection, using non-LAN systems communication technologies, of geographically separated IEEE 802[®] LANs below the level of the logical link control protocol.

- IEEE Std 802.1H[®] [ISO/IEC TR 11802-5] *Recommended Practice for Media Access Control (MAC) Bridging of Ethernet V2.0 in IEEE 802[®] Local Area Networks.*

- IEEE Std 802.1Q[®] *Virtual Bridged Local Area Networks.* Defines an architecture for Virtual Bridged LANs, the services provided in Virtual Bridged LANs, and the protocols and algorithms involved in the provision of those services.

- IEEE Std 802.2[®] [ISO/IEC 8802-2]: *Logical Link Control.*

- IEEE Std 802.3[®] [ISO/IEC 8802-3]: *CSMA/CD Access Method and Physical Layer Specifications.*

- IEEE Std 802.4[®] [ISO/IEC 8802-4]: *Token Bus Access Method and Physical Layer Specifications.*

- IEEE Std 802.5[®] [ISO/IEC 8802-5]: *Token Ring Access Method and Physical Layer Specifications.*

- IEEE Std 802.6[®] [ISO/IEC 8802-6]: *Distributed Queue Dual Bus Access Method and Physical Layer Specifications.*

- IEEE Std 802.10[®]: *Interoperable LAN/MAN Security.* Currently approved: Secure Data Exchange (SDE).

- IEEE Std 802.11[®]: [ISO/IEC 8802-11] *Wireless LAN Medium Access Control (MAC) Sublayer and Physical Layer Specifications.*

- IEEE Std 802.12[®]: [ISO/IEC 8802-12] *Demand Priority Access Method, Physical Layer and Repeater Specification.*

- IEEE Std 802.15[®]: *Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for: Wireless Personal Area Networks.*

- IEEE Std 802.16[®]: *Standard Air Interface for Fixed Broadband Wireless Access Systems.*

- IEEE Std 802.17[®]: *Resilient Packet Ring Access Method and Physical Layer 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 reader of this standard is urged to become familiar with the complete family of standards.

Conformance test methodology

An additional standards series, identified by the number 1802[™], has been established to identify the conformance test methodology documents for the IEEE 802[®] family of standards. Thus the conformance test documents for IEEE 802.3[®] are numbered 1802.3[™], the conformance test documents for IEEE 802.5[®] will be 1802.5[™], and so on. Similarly, ISO will use 18802 to number conformance test standards for 8802 standards.

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IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture

1. Scope

1.1 General

This document serves as the foundation for the family of IEEE 802[®] Standards published by IEEE for Local Area Networks (LANs) and Metropolitan Area Networks (MANs). It contains descriptions of the networks considered as well as a reference model (RM) for protocol standards. Compliance with the family of IEEE 802[®] Standards is defined, and a standard for the identification of public, private, and standard protocols is included.

1.2 Key concepts

The LANs described herein are distinguished from other types of data networks in that they are optimized for a moderate-sized geographic area, such as a single office building, a warehouse, or a campus. An IEEE 802[®] LAN is a peer-to-peer communication network that enables stations to communicate directly on a point-to-point, or point-to-multipoint, basis without requiring them to communicate with any intermediate switching nodes. LAN communication takes place at moderate-to-high data rates, and with short transit delays, on the order of a few milliseconds or less.

A LAN is generally owned, used, and operated by a single organization. This is in contrast to Wide Area Networks (WANs) that interconnect communication facilities in different parts of a country or are used as a public utility.

A MAN is optimized for a larger geographical area than is a LAN, ranging from several blocks of buildings to entire cities. As with local networks, MANs can also depend on communications channels of moderate-to-high data rates. A MAN might be owned and operated by a single organization, but it usually will be used by many individuals and organizations. MANs might also be owned and operated as public utilities. They will often provide means for internetworking of local networks.

Although primarily aimed at deployment on the scale of a large building or a campus, LANs are also frequently applied in smaller areas, such as small offices or single laboratories, and increasingly in homes. At the small-scale application level, a LAN is different from the type of network, such as a data bus or backplane bus, that is optimized for the interconnection of devices on a desktop or of components within a

single piece of equipment. However, desktop-scale applications of LANs are also possible, particularly where the nature of the application is more suited to peer-to-peer communication among autonomous components, as opposed to a system structure with more centralized control.

The original IEEE 802[®] LAN technologies used shared-medium communication, with information broadcast for all stations to receive. That approach has been varied and augmented subsequently, but in ways that preserve the appearance of simple peer-to-peer communications behavior for end stations. In particular, the use of bridges (see 6.3.2) for interconnecting LANs is now widespread. These devices allow the construction of networks with much larger numbers of LAN end stations, and much higher aggregate throughput, than would be achievable with a single shared-medium LAN. End stations attached to such a bridged LAN can communicate with each other just as though they were attached to a single shared-medium LAN (however, the ability to communicate with other stations can be limited by use of management facilities in the bridges, particularly where broadcast or multicast transmissions are involved). A further stage in this evolution has led to the use of point-to-point full duplex communication in LANs, either between an end station and a bridge or as a typically high-speed link between a pair of bridges.

The basic communications capabilities provided by all LANs and MANs are packet-based, as opposed to either cell-based or isochronous. That is, the basic unit of transmission is a sequence of data octets, which can be of any length within a range that is dependent on the type of LAN; for all LAN types, the maximum length is in excess of 1000 octets. (By contrast, cell-based communication transmits data in shorter, fixed-length units; isochronous communication transmits data as a steady stream of octets, or groups of octets, at equal time intervals.)

An optional function that may be offered by a LAN or a MAN is the provision of local networking of isochronous bearer services that are compatible with, or higher speed versions of, Integrated Services Digital Networks (ISDN) as defined by the ITU-T I-series Recommendations, to support voice, video, and data devices and terminals. These services are based on the use of end-user to end-user isochronous bearers that will span the supporting Integrated Services LAN (ISLAN) or MAN and an intervening ISDN-conformant WAN. Typically, the information streams for packet and isochronous services are multiplexed over the same physical media. In addition, capabilities are specified for a single integrated management of these various streams.

1.3 Application and support

The networks are intended to have wide applicability in many environments. The primary aim is to provide for moderate-cost devices and networks, suitable for commercial, educational, governmental, and industrial applications. Low-cost alternatives are possible for some networks, and application in other environments is not precluded. The following lists are intended to show some applications and devices and, as such, are not intended to be exhaustive, nor do they constitute a set of required items:

- File transfer
- Graphics
- Text processing
- Desktop publishing
- Electronic mail
- Database access
- Transaction processing
- Multimedia
- Office automation

- Process control
- Robotics
- Integrated Services (voice, video and data) applications
- Client/server applications

The networks are intended to support various data devices, such as the following:

- Computers
- Terminals
- Mass storage devices
- Printers and plotters
- Photocopiers and facsimile machines
- Image and video monitors
- Wireless terminals
- Monitoring and control equipment
- Bridges, routers, and gateways
- Integrated Services devices, including ISDN terminals and end systems supporting combined voice, video, and data applications

1.4 An international family of standards

The terms LAN and MAN encompass a number of data communications technologies and applications of these technologies. So it is with the IEEE 802® Standards. In order to provide a balance between the proliferation of a very large number of different and incompatible local and metropolitan networks, on the one hand, and the need to accommodate rapidly changing technology and to satisfy certain applications or cost goals, on the other hand, several types of medium access technologies are currently defined in the family of IEEE 802® Standards. In turn, these medium access control (MAC) standards are defined for a variety of physical media. A logical link control (LLC) standard, a secure data exchange standard, and MAC bridging standards are intended to be used in conjunction with the MAC standards. In some ISLAN and MAN standards, provisions are made for optionally conveying isochronous bearer services in support of continuous voice, video, and synchronous data applications. An architecture and protocols for the management of IEEE 802® LANs are also defined.

The IEEE 802® Standards have been developed and applied in the context of an increasingly global data communications industry. This global context is recognized in that most IEEE 802® Standards are progressed to become also international standards, within ISO/IEC JTC 1 (Joint Technical Committee 1, Information Technology, of the International Organization for Standardization and the International Electrotechnical Commission); see Clause 2 and Annex A.

2. References

The following publications contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

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

ISO/IEC 8802-2:1998 (IEEE Std 802.2-1998[™]), Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 2: Logical Link Control.

ISO/IEC TR 11802-1:1997, Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Technical reports and guidelines—Part 1: The structure and coding of Logical Link Control addresses in Local Area Networks.

ISO/IEC TR 11802-2:1999, Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Technical reports and guidelines—Part 2: Standard Group MAC Addresses.

ISO/IEC 15802-1:1995, Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Common specifications—Part 1: Medium access control (MAC) service definition.

ISO/IEC 15802-3:1998 (IEEE Std 802.1D-1998[™]), Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Common specifications—Part 3: Media Access Control (MAC) Bridges.

NOTE—Annex A lists, for information, the other LAN/MAN and related standards. Unlike those listed above, they do not contain detailed provisions that are used, by reference, by this standard.

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this standard, the following definitions apply. *The Authoritative Dictionary of IEEE Standards Terms*, Seventh Edition [B2],² should be referenced for terms not defined in this clause.

3.1.1 access domain: A set of LAN or MAN stations together with interconnecting data transmission media and related equipment (e.g., connectors, repeaters), in which the LAN or MAN stations use the same MAC protocol to establish the sequence of stations that are in temporary control of the shared transmission media.

3.1.2 bit-reversed representation: The representation of a sequence of octet values in which the values of the individual octets are displayed in order from left to right, with each octet value represented as a two-digit hexadecimal numeral, and with the resulting pairs of hexadecimal digits separated by colons. The order of the hexadecimal digits in each pair, and the mapping between the hexadecimal digits and the bits of the octet value, are derived by reversing the order of the bits in the octet value and interpreting the resulting bit sequence as a binary numeral using the normal mathematical rules for digit significance.

NOTE—The bit-reversed representation is applicable to LAN MAC addresses for use in a Token Ring (IEEE 802.5[®]) or FDDI environment. See Figure 8 for a comparative example of bit-reversed and hexadecimal representation.

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²The numbers in brackets correspond to those of the bibliography in Annex A.