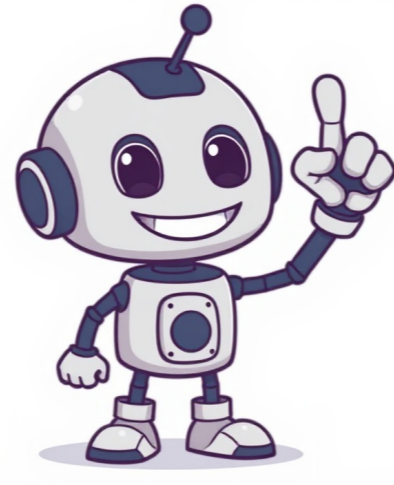


I'm not a robot



























IEEE 802.1 Project's Working Group Develops Set of Standards for Data Networking ===== The IEEE 802.1 working group is a part of the IEEE 802 project under the IEEE Standards Association. It focuses on [1] 802 LAN/MAN architecture, internetworking among 802 LANs, MANs and wide area networks; 802 Link Security; and overall network management protocol layers above the MAC and LLC layers. Standard Description Status 802.1B-1992 LAN/MAN Management Withdrawn in 2004 802.1k-1993 Discovery and Dynamic Control of Event Forwarding (Amendment to 802.1B-1992) Withdrawn in 2004 802.1D-1990 MAC Bridges Superseded by 802.1D-2004 P802.1r GARP Proprietary Attribute Registration Protocol (GPRP) Withdrawn 802.1t-2001 Technical and Editorial corrections for 802.1D-1998 Incorporated into 802.1D-1998 P802.1p Traffic Class Expediting and Dynamic Multicast Filtering Merged into 802.1D-1998 802.1D-1998 MAC Bridges (rollup of 802.1D-1990, 802.1j, 802.6k, P802.12e and P802.1p) Superseded by 802.1D-2004 P802.1r GARP Proprietary Attribute Registration Protocol (GPRP) Withdrawn 802.1t-2001 Technical and Editorial corrections for 802.1D-1998 Incorporated into 802.1D-2004 P802.1w-2001 Rapid Reconfiguration of Spanning Tree Incorporated into 802.1D-2004 P802.1y Maintenance to 802.1D-1998 Merged into 802.1D-2004 802.1D-2004 MAC Bridges (rollup of 802.1D-1998, 802.1t, 802.1w, P802.1y, and 802.11c) Incorporated into 802.1Q-2014[3] 802.1E-1990 System Load Protocol Withdrawn in 2004 802.1m-1993 Managed objects for System Load Protocol (Amendment to 802.1E-1990) Withdrawn in 2004 802.1F-1993 Common Definitions and Procedures for IEEE 802 Management Information Withdrawn in 2009 802.1G-1996 Remote MAC Bridging Withdrawn in 2009 802.1H-1995 Ethernet MAC Bridging Withdrawn in 2011 802.1Q-1998 Virtual Bridged Local Area Networks Superseded by 802.1Q-2003 802.1u-2001 VLAN Classification by Protocol and Port Incorporated into 802.1Q-2003 802.1u-2001 Technical and Editorial corrections for 802.1Q-1998 Incorporated into 802.1Q-2003 802.1s-2002 Multiple Spanning Tree Protocol Incorporated into 802.1Q-2003 802.1Q-2003 Virtual Bridged Local Area Networks (Rollup of 802.1Q-1998, 802.1s, 802.1u and 802.1v) Superseded by 802.1Q-2005 P802.1z Maintenance to 802.1Q-2003 Merged into 802.1Q-2005 802.1Q-2005 Virtual Bridged Local Area Networks (Rollup of 802.1Q-2003 and P802.1z) Superseded by 802.1Q-2011 802.1ad-2005 Provider Bridging Incorporated into 802.1Q-2011 802.1ak-2007 Replace GARP with Multiple Registration Protocol (MRP), MVRP and MMRP. Incorporated into 802.1Q-2011 802.1ag-2007 Connectivity Fault Management Incorporated into 802.1Q-2011 802.1ah-2008 Provider Backbone Bridge (PBB) Incorporated into 802.1Q-2011 802.1Q-2005/Cor1-2008 Technical corrections for Multiple Registration Protocol Incorporated into 802.1Q-2011 802.1ap-2008 Management Information Base (MIB) definitions for VLAN Bridges Incorporated into 802.1Q-2011 Path Bridging (SPB) Incorporated into 802.1Q-2014 Bridge port Extension / VN-Tag Merged into 802.1BR-2012 Equal Cost Multiple Paths (for Shortest Path Bridging)[7] Incorporated into 802.1Q-2014 Bridges and Bridged Networks (Rollup of 802.1Q-2011+Cor2 and 802.1Qb-2015 [9] Path Control and Reservation Incorporated into 802.1Q-2018 802.1Qca-2015 [9] Path Control and Reservation Incorporated into 802.1Q-2018 Application Virtual Local Area Network (VLAN) Type, Length, Value (TLV) (Data Center Bridging eXchange (DCBX) protocol application-specific TLVs) Incorporated into 802.1Q-2018 802.1Qbu-2016 Frame Preemption Incorporated into 802.1Q-2018 802.1Qbz-2016 Enhancements to Bridging of 802.11 Media Incorporated into 802.1Q-2018 802.1Qch-2017 Cyclic Queuing and Forwarding Incorporated into 802.1Q-2018 802.1Qci-2017 Per-Stream Filtering and Policing Incorporated into 802.1Q-2018 Bridges and Bridged Networks (Rollup of 802.1Q-2014+Cor1 and 802.1Qca/Qcd/Qbu/Qbv/Qbz/Qch/Qci)[10] Superseded by 802.1Q-2022 802.1Qcc-2018 Stream Reservation Protocol (SRP) Enhancements and Performance Improvements Incorporated into 802.1Q-2022 802.1Qcp-2018 YANG Data Model Incorporated into 802.1Q-2022 802.1Qcy-2019 Virtual Station Interface (VSI) Discovery and Configuration Protocol (VDP) Incorporated into 802.1Q-2022[11] 802.1Qcr-2020 Bridges and Bridged Networks: Asynchronous Traffic Shaping Incorporated into 802.1Q-2022[12] 802.1Qcx-2020 YANG Data Model for Connectivity Fault Management Incorporated into 802.1Q-2022 802.1Q-2022 Bridges and Bridged Networks (Rollup of 802.1Qcc/Qcy/Qcr) Current[13] 802.1Qcj-2023 Automatic Attachment to Provider Backbone Bridging (PBB) services Current[14][15] 802.1Qcw-2023 YANG Data Models for Scheduled Traffic, Frame Preemption, and Per-Stream Filtering and Policing Current[16][17] 802.1Qcz-2023 Congestion Isolation Current[18][19] 802.1Qdl-2024 Configuration Enhancements for Time-Sensitive Networking Current[20][21] 802.1Qdq Shaper Parameter Settings for Bursty Traffic Requiring Bounded Latency in progress[22] 802.1Qdt Priority-based Flow Control Enhancements in progress[23] 802.1Qdv Enhancements to Cyclic Queuing and Forwarding in progress[24] 802.1Qdw Source Flow Control in progress[25] 802.1Qdx YANG Data Models for the Credit-Based Shaper in progress[26] 802.1Qdy YANG for the Multiple Spanning Tree Protocol in progress[27] 802.1Q-Rev Bridges and Bridged Networks (Roll-up of 802.1Qcj/Qcz/Qcw) in progress[28] 802.1X-2001 Port Based Network Access Control Superseded by 802.1X-2004 P802.1af Media Access Control (MAC) Key Security Merged into 802.1X-2010 802.1X-2010 Port Based Network Access Control Superseded by 802.1X-2020[29] 802.1Xbx-2014 MAC Security Key Agreement protocol (MKA) extensions Incorporated into 802.1X-2020[30] 802.1Xck-2018 Port-Based Network Access Control YANG Data Model Incorporated into 802.1X-2020[31] 802.1X-2020 Port-Based Network Access Control Current[32] 802.1AB-2005 Station and Media Access Control Connectivity Discovery (LLDP) Superseded by 802.1AB-2009 802.1AB-2009 Station and Media Access Control Connectivity Discovery (LLDP) Superseded by 802.1AB-2016 802.1AB-2009/Cor 1-2013 Technical corrections for Station and Media Access Control Connectivity Discovery (LLDP) Incorporated into 802.1AB-2016 ===== The current status of various IEEE 802 standards shows a steady stream of updates and revisions aimed at enhancing network performance, security, and functionality. The development of various 802.1 standards is being pursued by the IEEE LAN/MAN Standards Committee, with some currently available at no cost and others requiring a fee to access. ===== Looking forward to seeing everyone at the meeting tomorrow to discuss our strategy for standardization and provisioning quality of service in network systems. ===== The IEEE 802.1AC standard from 2016 defined the Media Access Control (MAC) service for local and metropolitan area networks. This standard was later revised with Corrigendum 1, which addressed Logical Link Control (LLC) encapsulation EtherType issues. In addition to the original standard, there were several amendments made to IEEE 802.1AC. These included Amendment 1: Support for IEEE Std 802.15.3 and MAC Service Definition Amendment; Support for IEEE Std 802.15.6. Other related standards in this area include IEEE 802.1AS-2020, which covers Timing and Synchronization for Time-Sensitive Applications, and Corrigendum 1: Technical and Editorial Correction. The P802.1ASdm project is also ongoing, focusing on Hot Standby, while P802.1ASdn addresses YANG Data Model. The IEEE 802.1AX-2020 standard deals with Link Aggregation, providing a mechanism for improving network reliability by aggregating multiple links into a single logical link. This helps to increase bandwidth and reduce the likelihood of network outages. IEEE 802.1BA-2011/Cor 1-2016 is another important standard in this area, which focuses on Audio Video Bridging (AVB) Systems. It provides guidelines for ensuring high-quality audio and video transmission over local and metropolitan area networks. Furthermore, there are other standards that have been developed or proposed within the IEEE 802.1 community, such as Frame Replication and Elimination for Reliability (P802.1CB), which aims to improve network reliability by replicating frames and eliminating duplicates. Other related projects include P802.1CF Network Reference Model and Functional Description of IEEE 802 Access Network, P802.1CM Time-Sensitive Networking for Fronthaul, and P802.1CS Link-local Registration Protocol. These standards aim to provide a solid foundation for network communication, ensuring that devices can communicate reliably and efficiently over local and metropolitan area networks. ===== The early days of Ethernet saw the introduction of 10BASE5, a variant that utilized thick coaxial cables for data transmission. This technology was standardized in 1982 as IEEE 802.3 and supported up to 100 stations per segment, with each station sharing a 10 Mbit/s bandwidth. The installation of 10BASE2 Ethernet is complicated by the need for precise cable piercing, as the stiff and inflexible coaxial cable can be difficult to bend around corners. One incorrect connection can cause the entire network to fail, making it challenging to identify the source of the issue.[8] The use of thin coaxial cables with BNC connectors was once prevalent in local area networking but has since become largely obsolete due to advancements in technology and the increasing demand for high-speed networking solutions. In 1988, Ethernet over twisted pair was introduced, operating at a speed of 10 Mbit/s, which competed with the use of thin coaxial cables. By 2003, Wi-Fi equipment had become widely available and affordable, further diminishing the need for traditional Ethernet standards like 10BASE2. As of 2011, IEEE 802.3 has deprecated this standard for new installations.[3]the maximum number of nodes that can be connected to a 10BASE2 segment is limited to 30[4] with a minimum distance of 0.5 metres (20 in) between devices.[5] in a 10BASE2 network, each stretch of cable is connected to the transceiver using a BNC T-connector,[a] with one stretch connected to each female connector of the T. the t-connector must be plugged directly into the network adaptor with no cable in between. The terminators in devices like Digital's DEMPR and DESPR are a crucial feature, as they can only be used at one end of the cable run due to their built-in termination. This limitation makes them suitable for specific applications where the need for flexibility is not necessary. ===== The built-in terminator in these devices restricts their usage to a single physical endpoint of the cable connection. As noted in Alex Djenguerian's article from June 1986, "Ethernet/Cheapernet Physical Layer Made Easy with DP6391/92", this feature provides an essential constraint for their intended use. ----- The limitations imposed by these built-in terminators are primarily due to the technical requirements of working with Ethernet cables. According to IEEE standards and specifications, such as IEEE 802.3-2012 and IEEE 802.3, a terminator is needed at one end of the cable run to prevent signal degradation and ensure reliable communication. ----- This technology has been utilized in various applications, including legacy installs where older Ethernet devices like L-com's Commercial-Grade Thinner (10Base-2) and Thickett (10Base-5) converters are used. The introduction of these devices marked a significant milestone in the development of computer networking infrastructure.The Logical Link Control (LLC) Layer: A Key Component of the OSI Model ===== LLC is a crucial part of the OSI model, serving as the upper layer of the data link layer. It was originally developed by the Institute of Electrical and Electronics Engineers (IEEE) in collaboration with the American National Standards Institute (ANSI), and later adopted by the International Organization for Standardization (ISO) in 1998. This standard remains integral to the family of IEEE 802 standards, which cover local and metropolitan networks. One of the primary functions of LLC is to provide a uniform interface for users accessing the data link service, typically at the network layer. It offers three types of services: unacknowledged connectionless mode, connection mode, and acknowledged connectionless mode, each with its own set of characteristics and use cases. LLC relies on the media access control (MAC) protocol, which is specific to the transmission medium being used, such as Ethernet or Token Ring. This component is essential for all IEEE 802 networks, except for Ethernet, which does not require LLC. The IEEE 802.2 sublayer adds additional information to messages sent between nodes on the same data link. This results in a packet referred to as an LLC protocol data unit (PDU), containing the LLC header and other essential information. The LLC header consists of DSAP (Destination Service Access Point) and SSAP (Source Service Access Point), along with a control field that facilitates communication mode, operation specification, and connection control. This layer allows for multiplexing of various upper-layer protocols above LLC by using SNAP extension values, which enable vendors to define their own protocol value spaces. The 9-bit or 16-bit HDLC-style Control field distinguishes between different modes of communication and specifies operations. LLC provides three operational modes: Type 1 (unacknowledged connectionless mode), Type 2 (connection-oriented mode with sequence numbering for guaranteed order), and Type 3 (acknowledged connectionless service). The use of multicasts and broadcasts reduces network traffic by propagating information to all stations on the same network, while maintaining no guarantees regarding frame order.The intended recipient of the message is determined through the LSAP fields, which are 8 bits in length. However, the lowest bit is set aside for specific functions, limiting the available values to 128 for general use. The lowest bit in the DSAP field indicates whether it represents an individual or group address. When this bit is 0, the remaining 7 bits identify an individual address, directing the packet to a single local service access point (LSAP). If the bit is 1, the 7 bits denote a group address, which targets multiple LSAPs. Similarly, the lowest bit in the SSAP field specifies if the packet is a command or response. A value of 0 signifies a command, while 1 indicates a response. The remaining 7 bits of the SSAP identify the originating LSAP (always an individual address). LSAP numbers are globally assigned by the IEEE to ensure unique identification of established international standards. Individual LSAP addresses include values like 0 (Null LSAP), 2 (Individual LLC Sublayer Mgt), 4 (SNA Path Control), and 126 (ISO 8208). Group DSAP addresses, such as 3 (Group LLC Sublayer Mgt) and 255 (Global DSAP), are used for broadcasting. Protocols like LLC operate directly on 802.2, while others use SNAP with IEEE 802.2, indicated by 0xAA in SSAP and DSAP. SNAP enables EtherType values or private protocols across IEEE 802 networks, supporting both datagram and connection-oriented services. Ethernet networks, however, use Ethernet II framing with EtherType 0x800 for IP and 0x806 for ARP. IPv4 and ARP are rarely encapsulated directly in 802.2 LLC frames without SNAP headers, relying instead on RFC 1042. Novell NetWare's IPX supports additional Ethernet frame types, including 802.3 raw. Networks can use diverse framings, though nodes with differing formats cannot communicate directly. The control field follows the destination and source SAPs. IEEE 802.2 was inspired by HDLC, sharing its three-part structure.The IEEE Standard for Information Technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements. Vol. Part 2: Logical Link Control, provides guidelines for various types of PDUs (Physical Data Units) used in local and metropolitan area networks. U-format PDUs are designed for connectionless applications and feature an 8-bit control field. I-format PDUs, on the other hand, are intended for connection-oriented applications and include a 16-bit control and sequence numbering field. S-format PDUs are used for supervisory functions at the LLC (Logical Link Control) layer. The U-format is identified by the value '11' in lower two bits of the single-byte control field and is commonly used in unacknowledged connectionless modes. Information transfer format PDUs, or I-format PDUs, are used in connection-oriented applications. Supervisory format PDUs, or S-format PDUs, are intended for supervisory functions. =====10BASE2 is a variant of Ethernet that utilizes thin coaxial cables terminated with BNC connectors to build local area networks. The standard was prevalent during the mid to late 1980s, offering a 10 Mbit/s data transfer rate. In contrast to twisted pair networks, which were gaining popularity at the time, 10BASE2 relied on a single coaxial cable. The legacy of 802.11 wireless networks has led to the obsolescence of 10BASE2 and 10BASE5 Ethernet standards, although devices still exist in certain locations.[2] As of 2011, IEEE 802.3 deprecated this standard for new installations.[3] The term 10BASE2 originates from its characteristics, including transmission speed of 10 Mbit/s, baseband signaling, and a maximum segment length of 185 meters (the actual length being 185 m). The use of Manchester coding in 10 Mbit/s Ethernet allows the clock to be recovered from the signal, but it doubles the signal bandwidth. The 10BASE2 coaxial cables have a maximum length of 607 ft (185 m) and can support a maximum of 30 nodes with a minimum distance of 20 inches between devices.[4] Each segment of cable is connected to the transceiver using a BNC T-connector,[a] which is then directly plugged into the network adaptor without any intervening cables. The termination of each end of the cable with a 50 Ω resistor is crucial, as missing or broken terminators can cause reflected signals that resemble collisions, preventing communication.[5] Some terminators have metallic chains for grounding purposes, but it's essential to ground only one end to avoid creating a ground loop and resulting network outages or data corruption. Wiring a 10BASE2 network demands extra care, as faulty connections are challenging to diagnose and can bring down the entire network.[6] Given these challenges, proprietary systems like EAD sockets failed to gain widespread adoption, likely due to lack of standardization. In contrast, 10BASE-T offered an upgrade path to higher speeds, but required hub-based connections, making it less suitable for small networks or easily concealed wiring. Overall, while 10BASE2 presented some advantages, such as minimal hardware cost and easy wiring, its limitations in scalability and fault tolerance ultimately led to its decline in favor of 10BASE-T.[7]The 10BASE2 Ethernet network interface used a type of wire called RG-58, which was inexpensive and flexible. This cable was also compatible with RG-59 and could be used to create a 10BASE2 connection. Some network interface controllers (NICs) included the 10BASE2 transceivers, allowing for direct connections using BNC connectors. Others provided AUI connectors, which external transceivers could connect to. These transceivers were not limited to 10BASE2 and could also be used with 10BASE5 or 10BASE-T. A few devices had built-in terminators that could only be used at one end of the cable run. The use of BNC connectors was promoted as a reliable alternative, but some alternatives like EAD sockets were also considered less error-prone. Various standards and specifications governed the use of 10BASE2 connections, including IEEE 802.3-2012. The medium attachment unit (MAU) specified the type of medium to be used, while cable sectioning controlled how much of the cable was active. Many devices supported 10BASE2 connections, including Ethernet switches, routers, and network interface cards. These connections were often used in legacy networks, and some converters were available for older systems that still used these standards.The Evolution of Ethernet Technology: A Historical Perspective ===== The term "Ethernet" originates from the name of the 1970s Dutch electronics company, Philips' Electrocommunicatie Division. The phrase is derived from a combination of words 'electricity' and 'household'. In this article, we will explore some key aspects of Ethernet technology. Early Development of Ethernet The earliest Ethernet development was centered around the 10BASE2 and 10BASE5 standards, which were designed to transmit data at speeds of up to 10 megabits per second over twisted-pair cables. The introduction of the 802.3 standard in 1983 brought about significant improvements to these early protocols. Advancements in Ethernet Technology The velocity factor played a crucial role in the development of faster Ethernet standards, such as 100BASE-TX and 1000BASE-T. These advancements enabled network administrators to increase their transmission speeds while minimizing signal degradation. Long Reach Ethernet Long Reach Ethernet emerged as a result of the increasing demand for faster data transfer rates. This technology allowed users to extend the reach of their networks over longer distances, making it more practical for widespread deployment. Modern Network Protocols In today's digital landscape, network protocols have become increasingly sophisticated. The OSI model provides a comprehensive framework for understanding these protocols, enabling seamless communication between devices on different networks. Media-Independent Interface One notable innovation in Ethernet technology is the introduction of media-independent interfaces. This feature allows users to connect their devices to various types of networks without compromising performance or data integrity. Legacy Systems and Their Implications Legacy systems, such as JetDirect and IBM RT PC, are an essential part of our technological heritage. These systems not only paved the way for modern computing but also serve as important references for understanding the evolution of Ethernet technology. Conclusion Throughout this article, we have explored various facets of Ethernet technology, from its early development to cutting-edge innovations. By examining these historical milestones and advancements, we can gain a deeper appreciation for the significant role that Ethernet has played in shaping our digital world.