**Definition: Ethernet** is a physical and data link layer technology for [local area networks (LANs)](http://compnetworking.about.com/cs/lanvlanwan/g/bldef_lan.htm). Ethernet was invented by engineer Robert Metcalfe.

When first widely deployed in the 1980s, Ethernet supported a maximum theoretical data rate of 10 [megabits per second (Mbps)](http://compnetworking.about.com/od/speedtests/g/kbps-mbps-gbps-network-bit-rates.htm). Later, so-called "[Fast Ethernet](http://compnetworking.about.com/od/ethernet/f/ethernet_cards.htm)" standards increased this maximum data rate to 100 Mbps. [Gigabit Ethernet](http://compnetworking.about.com/cs/gigabitethernet/g/bldef_gigaenet.htm) technology further extends peak performance up to 1000 Mbps, and 10 Gigabit Ethernet technology also exists.

[Higher level network protocols](http://compnetworking.about.com/od/networkprotocols/g/protocols.htm) like [Internet Protocol (IP)](http://compnetworking.about.com/od/networkprotocolsip/g/ip_protocol.htm) use Ethernet as their transmission medium. Data travels over Ethernet inside protocol units called *frames*.

The run length of individual [>Ethernet cables](http://compnetworking.about.com/od/ethernet/f/what-is-an-ethernet-cable.htm) is limited to roughly 100 meters, but Ethernet networks can be easily extended to link entire schools or office buildings using [network bridge](http://compnetworking.about.com/cs/internetworking/g/bldef_bridge.htm) devices.

The most commonly installed Ethernet systems are called [100 BASE-T](http://searchnetworking.techtarget.com/definition/100BASE-T) (the "BASE-T" part means the systems use twisted-pair cabling) and provide transmission speeds up to 100 megabits per second ([Mbps](http://searchnetworking.techtarget.com/definition/Mbps)). [Gigabit Ethernet](http://searchnetworking.techtarget.com/definition/Gigabit-Ethernet) provides speeds of 1000 Mbps (1 gigabit or 1 billion bits per second) and 10 GbE, or [10-Gigabit Ethernet](http://searchnetworking.techtarget.com/definition/10-Gigabit-Ethernet), provides up to 10 Gbps, and so on. Higher speeds are constantly under development for standardization. Network engineers use 100 BASE-T mostly for the connection of end-user computers, printers and the like; 1000 BASE-T for servers and storage; and higher speeds for network-backbone segments. Over time, the speed typical in each kind of connection tends upwards.

For several decades, Ethernet has proven itself as a relatively inexpensive, reasonably fast, and very popular LAN technology. This tutorial explains the basic functionality of Ethernet and how it can be utilized on home and business networks.

**The History of Ethernet**

Engineers Bob Metcalfe and D.R. Boggs developed Ethernet beginning in 1972. Industry standards based on their work were established in 1980 under the IEEE 802.3 set of specifications.

[Ads](http://compnetworking.about.com/od/ethernet/fl/Introduction-to-Ethernet.htm)

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Ethernet specifications define low-level data transmission protocols and the technical details manufacturers need to know to build Ethernet products like cards and cables.

Ethernet technology has evolved and matured over a long time period. The average consumer can generally rely on off-the-shelf Ethernet products to work as designed and to work with each other.

**Ethernet Technology**

Traditional Ethernet supports data transfers at the rate of 10 [megabits per second (Mbps)](http://compnetworking.about.com/od/speedtests/g/kbps-mbps-gbps-network-bit-rates.htm). As the performance needs of networks increased over time, the industry created additional Ethernet specifications for **Fast Ethernet** and **Gigabit Ethernet**. Fast Ethernet extends traditional Ethernet performance up to 100 Mbps and Gigabit Ethernet up to 1000 Mbps speeds. Although products aren't yet available to the average consumer, 10 Gigabit Ethernet (10,000 Mbps) also exist and are used on some business networks and on [Internet2](http://compnetworking.about.com/od/internetaccessbestuses/fl/The-Internet2-Explained.htm).

Ethernet cables likewise are manufactured to any of several standard specifications. The most popular Ethernet cable in current use, Category 5 or [CAT5 cable](http://compnetworking.about.com/od/ethernet/g/cat5-cables.htm), supports both traditional and Fast Ethernet.

The Category 5e (CAT5e) and [CAT6](http://compnetworking.about.com/od/ethernet/g/cat6-cables.htm) cables supports Gigabit Ethernet.

To connect Ethernet cables to a computer (or other network device), a person plugs a cable directly into the device's [Ethernet port](http://compnetworking.about.com/od/ethernet/f/ethernet-port.htm). Some devices without Ethernet supports can also support Ethernet connections via [dongles](http://compnetworking.about.com/cs/ethernetcards/g/bldef_dongle.htm) such as [USB-to-Ethernet](http://compnetworking.about.com/od/usbnetworking/f/usbtoethernet.htm) adapters. Ethernet cables utilize connectors that look much like the RJ-45 connector used with traditional telephones.

For students: In the OSI model, Ethernet technology operates at the physical and data link layers - Layers One and Two respectively. Ethernet supports all popular network and higher-level protocols, principally [TCP/IP](http://compnetworking.about.com/cs/basictcpip/g/bldef_tcpip.htm).

**Types of Ethernet**

Often referred to as **Thicknet**, **10Base5** was the first incarnation of Ethernet technology. The industry used Thicknet in the 1980s until **10Base2** **Thinnet** appeared. Compared to Thicknet, Thinnet offered the advantage of thinner (5 millimeters vs 10 millimeters) and more flexible cabling, making it easier to wire office buildings for Ethernet.

The most common form of traditional Ethernet, however, was **10Base-T**. 10Base-T offers better electrical properties than Thicknet or Thinnet, because 10Base-T cables utilize unshielded twisted pair (UTP) wiring rather than coaxial. 10Base-T also proved more cost effective than alternatives like fiber optic cabling.

Numerous other lesser-known Ethernet standards exist, including 10Base-FL, 10Base-FB, and 10Base-FP for fiber optic networks and 10Broad36 for [broadband](http://compnetworking.about.com/library/glossary/bldef-broadband.htm) (cable television) cabling. All of the above traditional forms, including 10Base-T have been made obsolete by Fast and Gigabit Ethernet.

**More About Fast Ethernet**

In the mid-1990s, Fast Ethernet technology matured and met its design goals of a) increasing the performance of traditional Ethernet while b) avoiding the need to completely re-cable existing Ethernet networks. Fast Ethernet comes in two major varieties:

* 100Base-T (using unshielded twisted pair cable)
* 100Base-FX (using fiber optic cable)

By far the most popular of these is **100Base-T**, a standard that includes 100Base-TX (Category 5 UTP), 100Base-T2 (Category 3 or better UTP), and 100Base-T4 (100Base-T2 cabling modified to include two additional wire pairs).

**More About Gigabit Ethernet**

While Fast Ethernet improved traditional Ethernet from 10 Megabit to 100 Megabit speed, Gigabit Ethernet boasts the same order-of-magnitude improvement over Fast Ethernet by offering speeds of 1000 Megabits (1 Gigabit). Gigabit Ethernet was first made to travel over optical and copper cabling, but the 1000Base-T standard successfully supports it as well. 1000Base-T uses Category 5 cabling similar to 100 Mbps Ethernet, although achieving gigabit speed requires the use of additional wire pairs.

**Ethernet Topologies and Protocols**

Traditional Ethernet employs a **bus** topology, meaning that all devices or **hosts** on the network use the same shared communication line. Each device possesses an Ethernet address, also known as [MAC address](http://compnetworking.about.com/od/networkprotocolsip/g/bldef_mac.htm). Sending devices use Ethernet addresses to specify the intended recipient of messages.

Data sent over the Ethernet exists in the forms of **frames**. An Ethernet frame contains a header, a data section, and a footer having a combined length of no more than 1518 bytes. The Ethernet header contains the addresses of both the intended recipient and the sender.

Data sent over the Ethernet is automatically **broadcast** to all devices on the network. By comparing their Ethernet address against the address in the frame header, each Ethernet device tests each frame to determine if it was intended for them and reads or discards the frame as appropriate. [Network adapters](http://compnetworking.about.com/library/glossary/bldef-adapter.htm) incorporate this function into their hardware.

Devices wanting to transmit on the Ethernet first perform a preliminary check to determine whether the medium is available or whether a transmission is currently in progress. If the Ethernet is available, the sending device transmits onto the wire. It's possible, however, that two devices will perform this test at approximately the same time and both transmit simultaneously.

By design, as a performance trade-off, the Ethernet standard does not prevent multiple simultaneous transmission. These so-called **collisions**, when they occur, cause both transmissions to fail and require both sending devices to re-transmit. Ethernet uses a algorithm based on random delay times to determine the proper waiting period between re-transmissions. The network adapter also implements this algorithm.

In traditional Ethernet, this protocol for broadcasting, listening, and detecting collisions is known as **CSMA/CD** (Carrier Sense Multiple Access / Collision Detection). Some newer forms of Ethernet do not use CSMA/CD. Instead, they use the so-called **full duplex** Ethernet protocol, which supports point-to-point simultaneous sends and receives with no listening required.

**More About Ethernet Devices**

As mentioned earlier, Ethernet cables are limited in their reach, and those distances (as short as 100 meters) are insufficient to cover medium-sized and large network installations. A **repeater** in Ethernet networking is a device that allows multiple cables to be joined and greater distances to be spanned. A **bridge** device can join an Ethernet to another network of a different type, such as a wireless network. One popular type of repeater device is an Ethernet [hub](http://compnetworking.about.com/library/glossary/bldef-hub.htm). Other devices sometimes confused with hubs are [switches](http://compnetworking.about.com/library/glossary/bldef-switch.htm) and [routers](http://compnetworking.about.com/library/glossary/bldef-router.htm).

Ethernet network adapters also exist in multiple forms. Newer personal computers and game consoles feature a built-in Ethernet adapter. USB-to-Ethernet adapters and wireless Ethernet adapters can also be configured to work with many newer devices.

**Summary**

Ethernet is one of the Internet's key technologies. Despite its advanced age, Ethernet continues to power many of the world's local area networks and continually is improving to meet future needs for high-performance networking.

Ethernet is the most widely installed local area network (LAN) technology. Ethernet is a [*link layer*](http://searchnetworking.techtarget.com/definition/Data-Link-layer) protocol in the [TCP/IP stack](http://searchnetworking.techtarget.com/definition/TCP-IP), describing how networked devices can format data for transmission to other network devices on the same network segment, and how to put that data out on the network connection. It touches both Layer 1 (the physical layer) and [Layer 2](http://searchnetworking.techtarget.com/definition/layer-2)  (the data link layer) on the OSI network protocol model. Ethernet defines two units of transmission, packet and frame. The frame includes not just the "payload" of data being transmitted but also addressing information identifying the physical "Media Access Control" (MAC) addresses of both sender and receiver, VLAN tagging and [quality of service](http://searchunifiedcommunications.techtarget.com/definition/QoS-Quality-of-Service) information, and error-correction information to detect problems in transmission. Each frame is wrapped in a packet, which affixes several bytes of information used in establishing the connection and marking where the frame starts.

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Specified in the family of standards known as IEEE [802.3](http://searchnetworking.techtarget.com/definition/8023), Ethernet was originally developed by Xerox in the 1970s. Ethernet was initially designed to run over coaxial cables, but a typical Ethernet LAN now uses special grades of [twisted pair](http://searchdatacenter.techtarget.com/definition/twisted-pair) cables, or fiber optical cabling. Wi-Fi standards (IEEE 802.11a, b, g, n and now ac) define the equivalent of Ethernet for [Wireless LAN](http://searchmobilecomputing.techtarget.com/definition/wireless-LAN)s.) Ethernet standards are steadily evolving to embrace new media, higher transmission speeds and changes in frame content (e.g., 802.3ac to accommodate [VLAN](http://searchnetworking.techtarget.com/definition/virtual-LAN) and priority tagging) and functional requirements (e.g., 802.3af, defining [Power Over Ethernet [POE]](http://searchnetworking.techtarget.com/definition/Power-over-Ethernet) crucial to most Wi-Fi and IP telephony deployments).

Ethernet initially assumed a shared medium: multiple devices on each segment of the network, connected daisy chain at first but later in star topology via Ethernet hubs (which replicated all traffic received on any port to every other port). It therefore defines a means of sharing the medium: Carrier Sense Multiple Access with Collision Detection ([CSMA/CD](http://searchnetworking.techtarget.com/definition/Carrier-Sense-Multiple-Access-Collision-Detect)). Ethernet devices will check to see if anyone else is transmitting at the moment (carrier sense of multiple access) and if so (collision detection) will wait a short time before retrying the transmission. Over time, though, hubs were replaced by switches, which send to each port only the traffic directed to the device on that port. That, combined with the migration from coaxial to twisted pair cabling (with dedicated pairs for sending and receiving data) and optical fiber, made shared-medium problems a thing of the past.

The most commonly installed Ethernet systems are called [100 BASE-T](http://searchnetworking.techtarget.com/definition/100BASE-T) (the "BASE-T" part means the systems use twisted-pair cabling) and provide transmission speeds up to 100 megabits per second ([Mbps](http://searchnetworking.techtarget.com/definition/Mbps)). [Gigabit Ethernet](http://searchnetworking.techtarget.com/definition/Gigabit-Ethernet) provides speeds of 1000 Mbps (1 gigabit or 1 billion bits per second) and 10 GbE, or [10-Gigabit Ethernet](http://searchnetworking.techtarget.com/definition/10-Gigabit-Ethernet), provides up to 10 Gbps, and so on. Higher speeds are constantly under development for standardization. Network engineers use 100 BASE-T mostly for the connection of end-user computers, printers and the like; 1000 BASE-T for servers and storage; and higher speeds for network-backbone segments. Over time, the speed typical in each kind of connection tends upwards.