Ethernet Basics

Introduction

Ethernet is the most common network due, primarily, to the many protocols supported and its low cost. Originally developed by Intel, Digital (now Compaq), and Xerox, it is an open network standard (IEEE 802.3).

The Open Systems Interconnect (OSI), established in 1984 by the ISO (International Standards Organization), divides network functions into seven layers: Physical, Data Link, Network, Transport, Session, Presentation and Application Protocol.

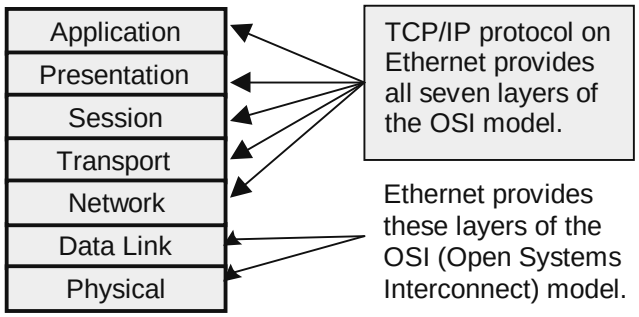

Figure 1. Ethernet and the OSI Model.

- The Physical Layer transforms data into bits that are sent across the physical media.
- The Data Link layer determines access to the network media in terms of frames. Its Media Access Control (MAC) sublayer is responsible for physical addressing.
- The Network Layer routes data through a large network.
- The Transport Layer provides end-to-end, reliable connections, often in terms of segments.
- The Session Layer allows users to establish connections using intelligently chosen names in packets.
- The Presentation Layer negotiates data exchange formats, also in terms of packets.

- Finally, the Application Layer provides the interface between the user's application and the network through messages.

Data is said to move from layer to layer within the seven layers of the OSI model.

Ethernet and the OSI Model

Ethernet supports the physical and data link layers. With TCP/IP as its protocol, it supports all seven layers of the OSI model.

Several types of Ethernet cables support the physical layer. See "Cabling and Cable Lengths" for details.

Using Carrier Sense Multiple Access/Collision Detection (CSMA/CD), Ethernet supports the data link layer. CSMA/CD checks the media for other devices before transmitting, managing data collisions and reducing the number of data collisions.

TCP/IP and the OSI Model

Ethernet uses Transmission Control Protocol/Internet Protocol (TCP/IP) to provide layers of the OSI model. Although developed under an older four-layer network model developed by the U.S. Department of Defense (DoD), we can loosely fit the four layers of the DoD model to the seven of the OSI model.

Physical and Data Link layers are supported through the Network Access layer of the DoD model. TCP/IP can run on many types of network connection, including ethernet. Ethernet supports both the Physical and Data Link layers of the OSI model.

The Network layer of the OSI model corresponds with the Internet layer of the DoD model. Internet Protocol provides this layer, moving data to other devices on the network.

The Transport layer corresponds to the Host-to-Host layer of the Dod model. Almost all devices on a TCP/IP network are considered hosts, and this layer communicates data peer-to-peer (or host-to-host).

The Session, Presentation and Application layers of the OSI model correspond to the Process/Application layer of the DoD model, providing network services.

Ethernet Network Topology

Devices on an Ethernet network are arranged in either a *bus* or *star* topology.

Bus

In a bus topology, all devices on the network connect to one trunk cable. This makes it easy to install and configure, and inexpensive. Ethernet in a bus topology requires no special equipment to amplify or regenerate the signal. Any device wanting to send information must first determine if the bus is being used by any other device. If no other device is attempting to transmit, the device sends the data. Bus networks generally require that proper terminations are made at each end of the trunk. If the trunk cable fails, all devices are affected.

Star

In a star topology, a separate cable connects each device with a central device, typically a hub. Unlike the bus topology, if a cable fails it affects only the one device connected to the failed cable. Star networks are easily expanded, easier to troubleshoot and support many types of cables. To connect more than two devices together in a star topology requires the use of either a passive or active hub. Passive hubs do not regenerate the signal. Use of active hubs extends network length by regenerating the signal and sending it across the network.

A typical PC-based network for operation of XYZ is depicted in Figure 2.

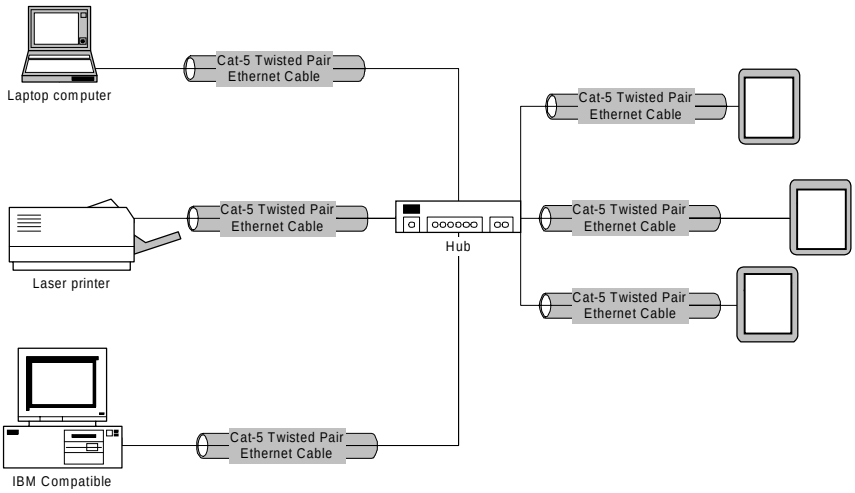

Figure 2. A typical local area network used for PC-based operation of XYZs.

Cabling and Cable Lengths

Ethernet supports several types of cables, each intended for different purposes:

- 10Base-T (Twisted-pair Ethernet) – The most widely used ethernet cabling, it supports network speeds of 100Mbps. Uses 22- or 26-AWG UTP cabling to transmit baseband signals on maximum 100-meter segments. RJ-45 jacks connect separate cables between device and hub. Each device must be at least 2 feet apart and no more than 328 feet from the hub. Bridges or routers may be used to accommodate a larger network. There is no limit on network length. It permits a maximum of 1,024 segments and 1,024 nodes. See IEEE standard 802.3i.
- 10Base-2 (Thin Ethernet) – Supports network speeds of 10Mbps. Uses RG-58 coaxial cable to transmit baseband signals on 200-meter segments. Total network length can be 925 meters. Transceivers reside on the NIC, simplifying connections. The cable, thinner than 10Base-5, is more flexible for easier handling. See IEEE standard 802.3a.
- 10Base-5 (Thick Ethernet) – Now rarely used, this cable was popular for desktop connections until the introduction of 10BaseT. It supports networks speeds of up to 10Mbps and uses RG-8 or RG-11 coaxial cable to transmit baseband signals in 500-meter (1,640 feet) segments. Total network length can be 2,500 meters with up to 300 nodes. It requires the use of transceivers located at least 8 feet apart and tapped into the cable. A 15-pin AUI, or DIX (Digital, Intel, Xerox) connector is used between the network cable and the AUI port on the Ethernet NIC (Network Interface Card). See IEEE standard 802.3 for details.

Ethernet Hub

An ethernet hub is required if connecting more than two devices (more than one XYZ and one computer). If only connecting a single XYZ with a single computer, you need only a special "crossover" or "uplink" Ethernet cable. (Contact your XYZ representative for cable information).