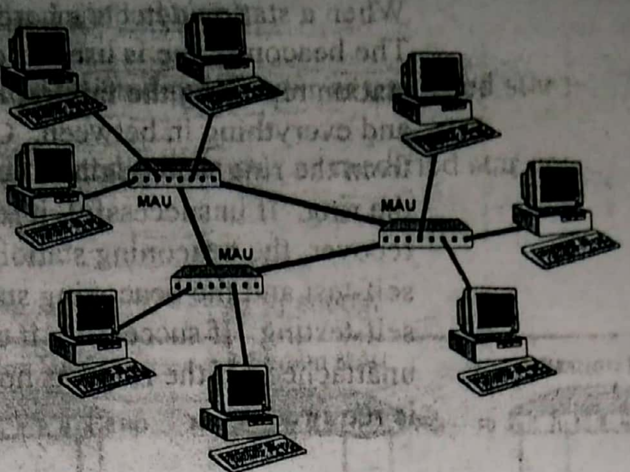
Token Passing



A Token is a control signal that is passed from station-to-station between transfers of data. It consists of a starting delimiter, an access control field, and an ending delimiter. The Token contains a single Bit (the Token Bit) that indicates that the token is ready to accept information. If the node has data to send, it appends the data to the token. The token then becomes a Frame. Only one token at a time is allowed to circulate around the ring.

A frame is a unit of data transmission and includes delimiters, control characters, information, and checking characters.

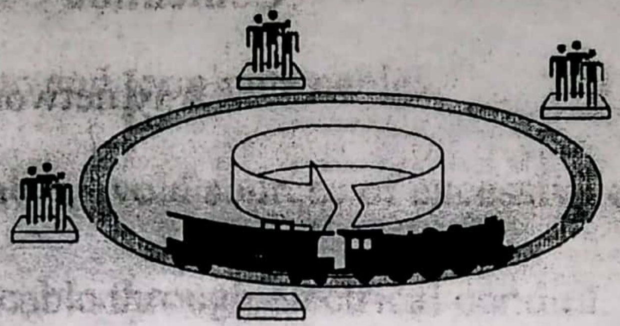
- When it wants to communicate, a station takes the token, flags it as busy (changes the Token bit to 1), loads it with data, and passes it on.
- The frame makes its way through the network to the receiving station, which takes the data, marks the frame as received (by changing 2 sets of bits in the FS byte), and passes it along.
- The frame returns to the sender, which sees the receipt (FS bits), removes the frame from the ring, and then releases a new token.
- An option called early token release allows a transmitting station to release a token after transmitting the ending delimiter of the frame.
- Each node acts as a repeater for the network.
- The node with the highest address will become the ring's active monitor.
- Every seven seconds or less, this active monitor will send a signal to the other nodes to identify itself as present.

The active monitor is responsible for verifying that the token is detected on the ring and generates a new token if it is missing. The active monitor will also remove continuously circulating frames.

Token Passing

A token is passed in an orderly fashion from one device to another. A device can access the channel by taking control of the token.

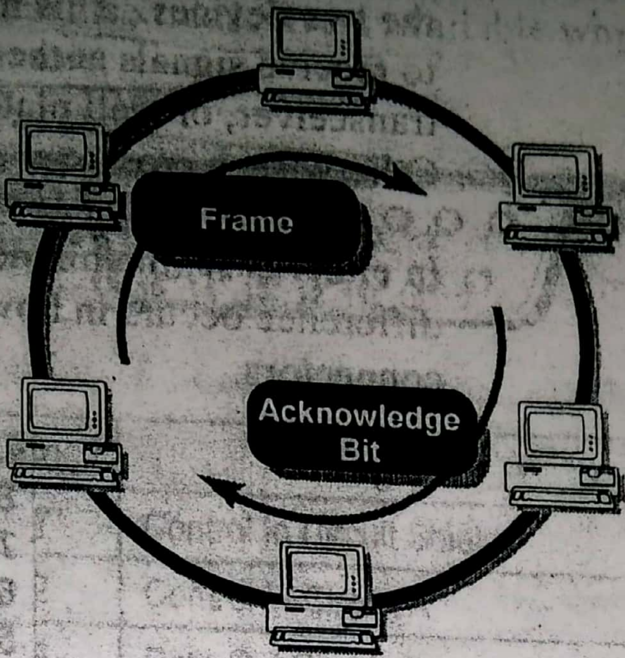
Protocol Examples: Token Ring, FDDI



Token Passing

The IEEE has produced standards for the MAC layer which utilize these channel access methods.

en Ring 802.5



Token Ring was originally created by IBM. Over the last few years, it has steadily gained popularity.

- Logical ring usually wired as a physical star.
- 4 Mbps/16 Mbps transfer rate.
- Unshielded twisted-pair, shielded twisted-pair, or fiber optic.
- Token (data frame) passes from system to system.
- A system can attach data to a token if the token is free (empty)
- Each system receives and regenerates the token.
- Deterministic, it is possible to predict the passage of the token

The predictability inherent in Token Ring makes it a popular choice for timing critical and control applications.

- Only one active token on the ring at the same time

Figure 12.3 *PDU format*

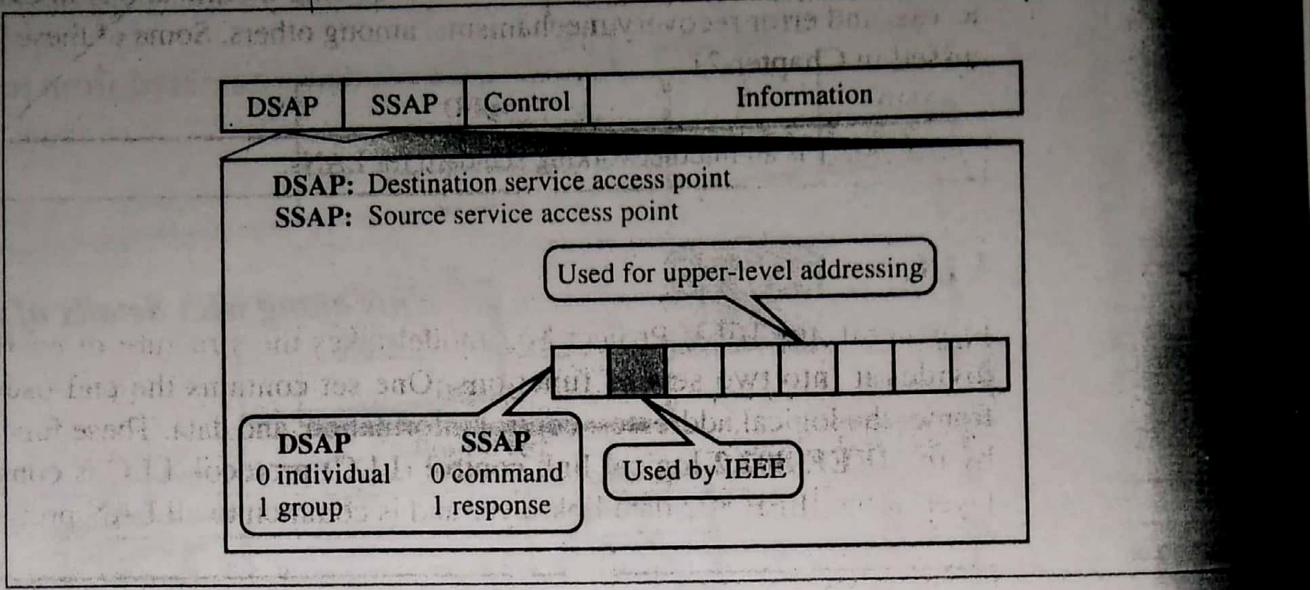
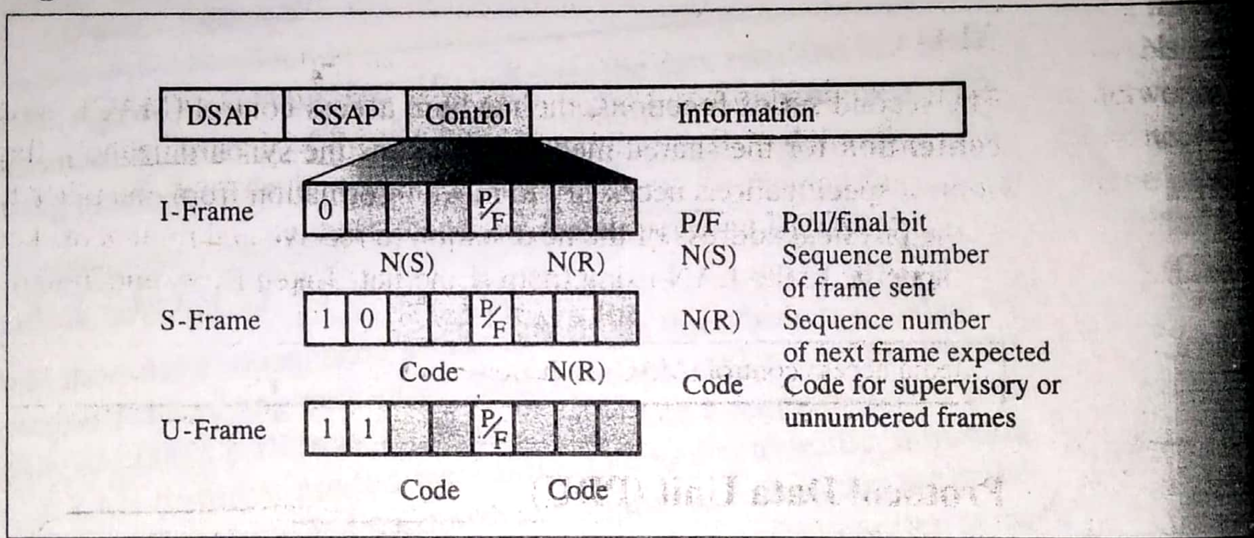


Figure 12.4 *Control field in a PDU*



The PDU has no flag fields, no CRC, and no station address. These fields are add[ed] in the lower sublayer (the MAC layer).

12.2 ETHERNET

IEEE 802.3 supports a LAN standard originally developed by Xerox and la[ter] extended by a joint venture between Digital Equipment Corporation, Intel Corporation and Xerox. This was called **Ethernet.**

IEEE 802.3 defines two categories: **baseband** and **broadband**, as shown [in] Figure 12.5. The word *base* specifies a digital signal (in this case, Manchester encod-ing). The word *broad* specifies an analog signal (in this case, PSK encoding). IEEE divides the baseband category into five different standards: **10Base5, 10Base2, 10Base-T, 1Base5,** and **100Base-T.** The first number (10, 1, or 100) indicates the da[ta] rate in Mbps. The last number or letter (5, 2, 1, or T) indicates the maximum ca[ble] length or the type of cable. IEEE defines only one specification for the broadba[nd]

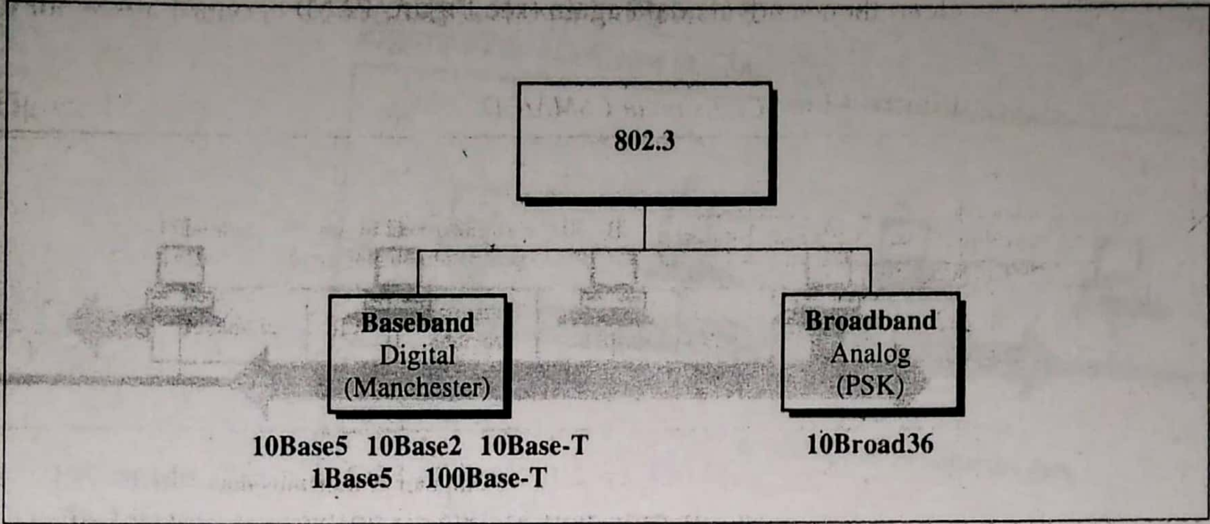
[illegible]	[illegible] laser	[illegible]	[illegible]	[illegible]
Max. distance	550 m	550 m (multimode) 5000 m (single mode)	25 m	25 m

12.4 TOKEN BUS (802.4)

Local area networks have a direct application in factory automation and process control, where the nodes are computers controlling the manufacturing process. In this type of application, real-time processing with minimum delay is needed. Processing must occur at the same speed as the objects moving along the assembly line. Ethernet (IEEE 802.3) is not a suitable protocol for this purpose because the number of collisions is not predictable and the delay in sending data from the control center to the computers along the assembly line is not a fixed value. **Token Ring (IEEE 802.5;** see next section) is also not a suitable protocol because an assembly line resembles a bus topology and not a ring. **Token Bus (IEEE 802.4)** combines features of Ethernet and Token Ring. It combines the physical configuration of Ethernet (a bus topology) and the collision-free (predictable delay) feature of Token Ring. Token Bus is a physical bus that operates as a logical ring using **tokens.**

Station are logicaly organized in to a ring. A token is passed among Stations. If a station ~~wants~~ wants to send data, It must waiat and capture the token. However, like Ethernet station Communicat via a common bus.

Figure 12.5 *IEEE 802.3*



category: 10Broad36. Again, the first number (10) indicates the data rate. The last number defines the maximum cable length. However, the maximum cable length restriction can be changed using networking devices such as repeaters or bridges (see Chapter 21).

Access Method: CSMA/CD

Whenever multiple users have unregulated access to a single line, there is a danger of signals overlapping and destroying each other. Such overlaps, which turn the signals into unusable noise, are called **collisions.** As traffic increases on a multiple-access link, so do collisions. A LAN therefore needs a mechanism to coordinate traffic, minimize the number of collisions that occur, and maximize the number of frames that are delivered successfully. The access mechanism used in an Ethernet is called **carrier sense multiple access with collision detection** (**CSMA/CD,** standardized in IEEE 802.3).

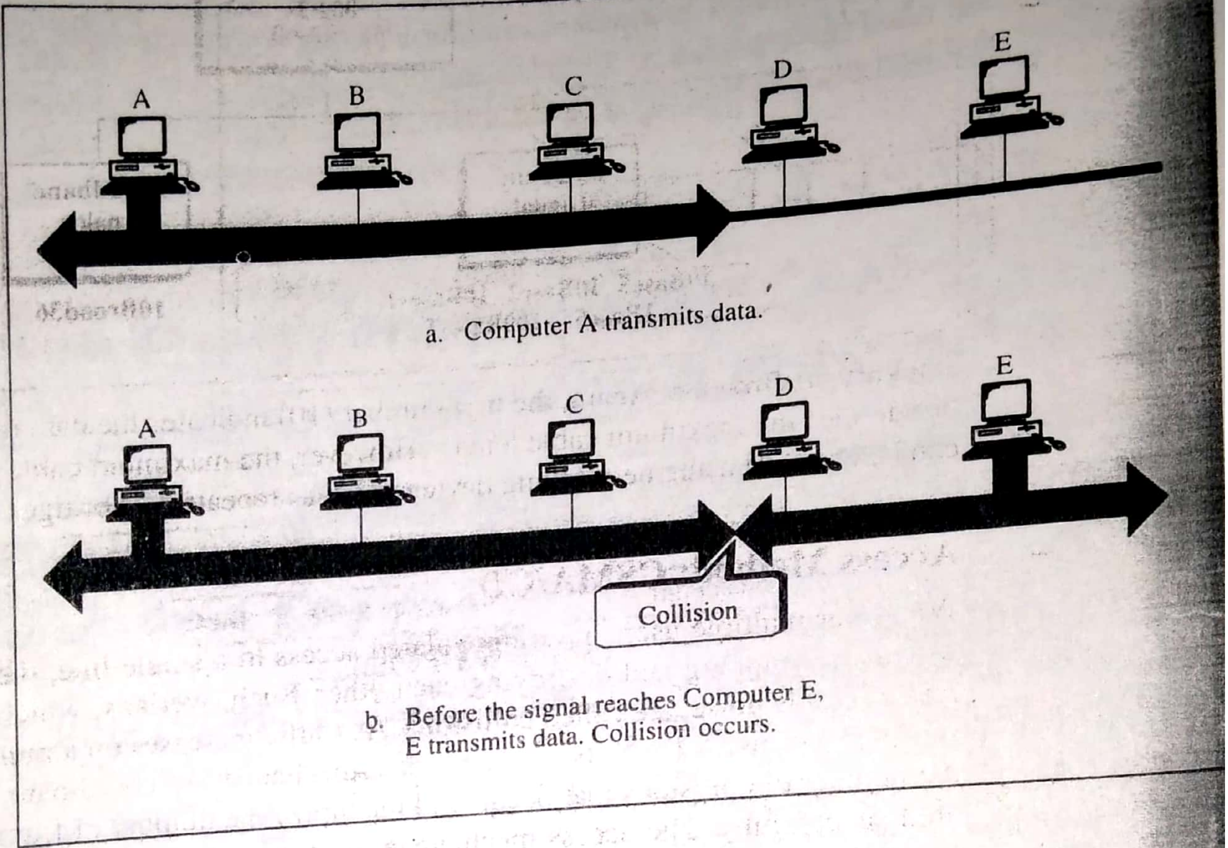
CSMA/CD is the result of an evolution from **multiple access** (**MA**) to **carrier sense multiple access** (**CSMA**), and, finally, to carrier sense multiple access with collision detection (CSMA/CD). The original design was a multiple access method in which every workstation had equal access to a link. In MA, there was no provision for traffic coordination. Access to the line was open to any node at any time, with the assumption that the odds of two devices competing for access at the same time were small enough to be unimportant. Any station wishing to transmit did so, then relied on acknowledgments to verify that the transmitted frame had not been destroyed by other traffic on the line.

In a CSMA system, any workstation wishing to transmit must first listen for existing traffic on the line. A device listens by checking for a voltage. If no voltage is detected, the line is considered idle and the transmission is initiated. CSMA cuts down on the number of collisions but does not eliminate them. Collisions can still occur. If another station has transmitted too recently for its signal to have reached the listening station, the listener assumes the line is idle and introduces its own signal onto the line.

The final step is the addition of collision detection (CD). In CSMA/CD the station wishing to transmit first listens to make certain the link is free, then transmits its data, then listens again. During the data transmission, the station checks the line for the extremely high voltages that indicate a collision. If a collision is detected, the station

quits the current transmission and waits a predetermined amount of time for the lin[e to be]
clear, then sends its data again (see Figure 12.6).

Figure 12.6 *Collision in CSMA/CD*



Addressing

Each station on an Ethernet network (such as a PC, workstation, or printer) has its ow[n]
network interface card (NIC). The NIC usually fits inside the station and provides th[e]
station with a six-byte physical address. The number on the NIC is unique.

Electrical Specification

Signaling

The baseband systems use Manchester digital encoding (see Chapter 5). There is on[e]
broadband system, 10Broad36. It uses digital/analog conversion (differential PSK).

Data Rate

Ethernet LANs can support data rates between 1 and 100 Mbps.

Frame Format

IEEE 802.3 specifies one type of frame containing seven fields: preamble, SFD, DA,
SA, length/type of PDU, 802.2 frame, and the CRC. Ethernet does not provide an
mechanism for acknowledging received frames, making it what is known as an unrel[iable]