Multiple Access

Figure 12.1 *Data link layer divided into two functionality-oriented sublayers*

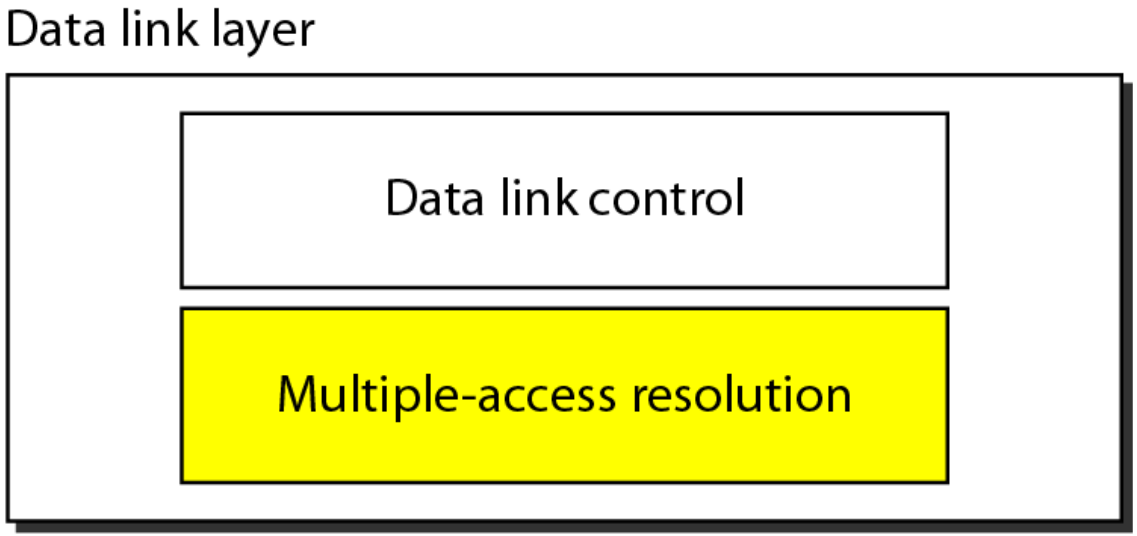
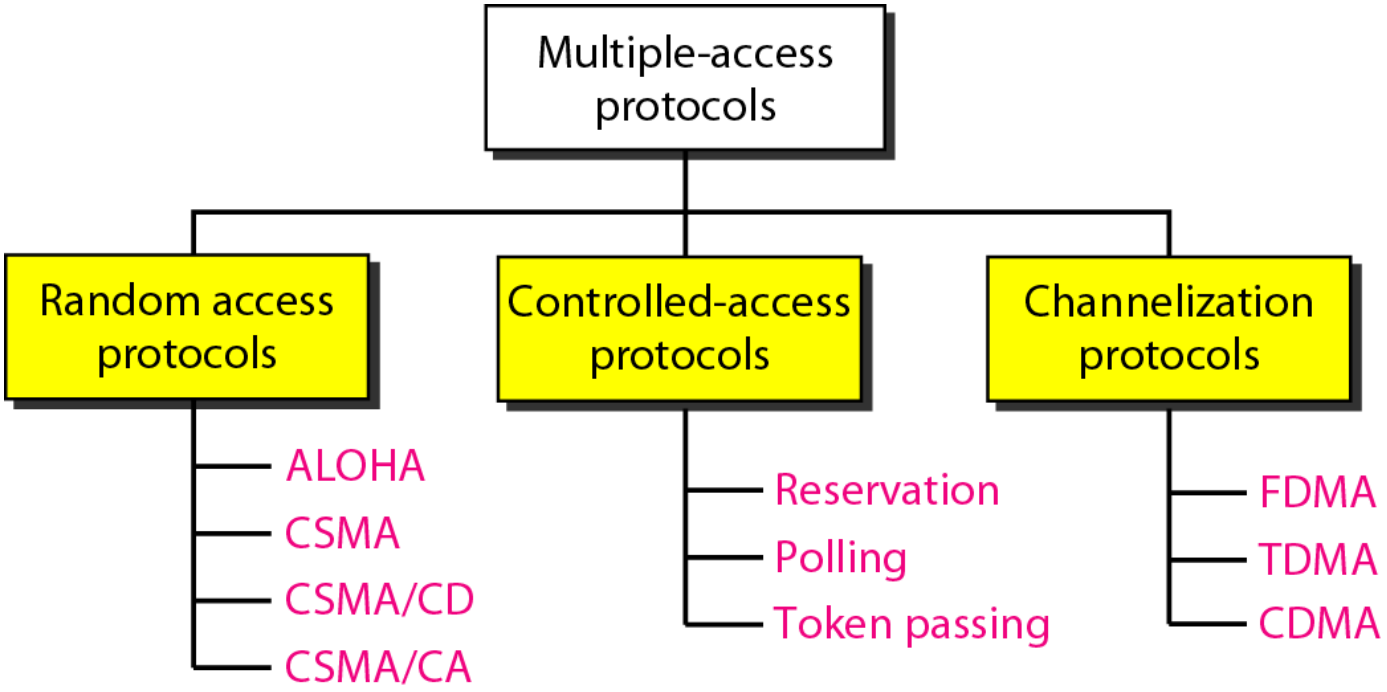


Figure 12.2 *Taxonomy of multiple-access protocols discussed in this chapter*



12-2 CONTROLLED ACCESS

In controlled access, the stations consult one another to find which station has the right to send. A station cannot send unless it has been authorized by other stations. We discuss three popular controlled-access methods.

Topics discussed in this section:

Reservation
Polling
Token Passing

12-3 CHANNELIZATION

Channelization *is a multiple-access method in which the available bandwidth of a link is shared in time, frequency, or through code, between different stations. In this section, we discuss three channelization protocols.*

Topics discussed in this section:

Frequency-Division Multiple Access (FDMA)
Time-Division Multiple Access (TDMA)
Code-Division Multiple Access (CDMA)

CDMA - Walsh tables

$$W_1 = [+1] \qquad W_{2N} = \begin{bmatrix} W_N & W_N \\ W_N & \overline{W_N} \end{bmatrix}$$

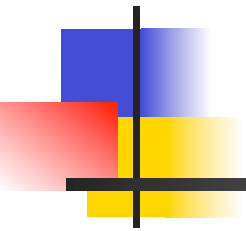
a. Two basic rules

$$W_1 = [+1]$$

$$W_2 = \begin{bmatrix} +1 & +1 \\ +1 & -1 \end{bmatrix}$$

$$W_4 = \begin{bmatrix} +1 & +1 & +1 & +1 \\ +1 & -1 & +1 & -1 \\ +1 & +1 & -1 & -1 \\ +1 & -1 & -1 & +1 \end{bmatrix}$$

b. Generation of W_1, W_2, and W_4



Medium Access Sub layer

Overview

- This is the sub layer of the Data Link Layer.
- Here we want to know how to handle broadcast networks.
- As compared to point to point networks, a major issue is handling arbitration when there is competition for the network.
  - The Channel Allocation Problem
  - Multiple Access Protocols
  - IEEE Standards for LANs
  - Bridges
  - High Speed LANs

IEEE Standard 802 For LANs and MANs

How do the protocols apply to real systems.
Here we talk about the actual standards in use.

802.2 Describes the upper part of the data link layer, the LLC (Logical Link Control).

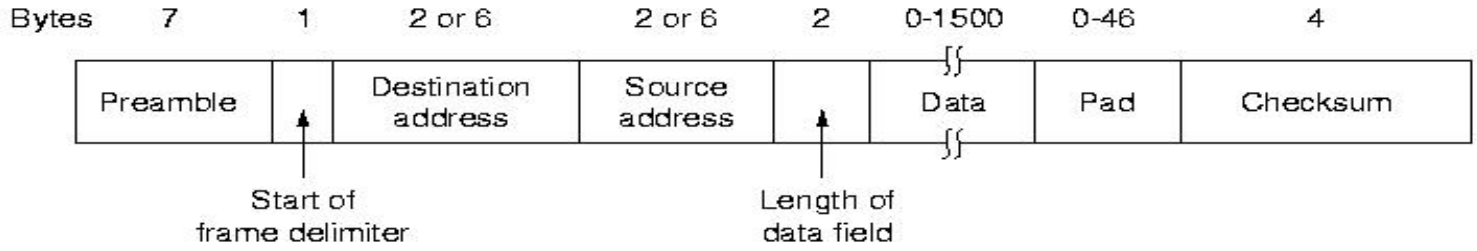
Descriptions of the physical and lower part of the DLL are:

802.3	*CSMA/CS LAN*
802.4	*Token Bus*
802.5	*Token Ring*

IEEE Standard 802.3

Preamble == 7 bytes of 10101010
Start == 1 byte of 10101011
Dest == 6 bytes of mac address
multicast == sending to a group of stations.
broadcast == (dest. = all 1's) to all stations on network
Source == 6 bytes of mac address
Length == number of bytes of data
Data == comes down from network layer
Pad == ensures 64 bytes from dest addr thru checksum.
checksum == 4 bytes of CRC.

The pad ensures transmission takes enough time so it's still being sent when the first bit reaches the destination. The frame needs to still be going out when the noise burst
from another stations collision detection gets back to the sender.



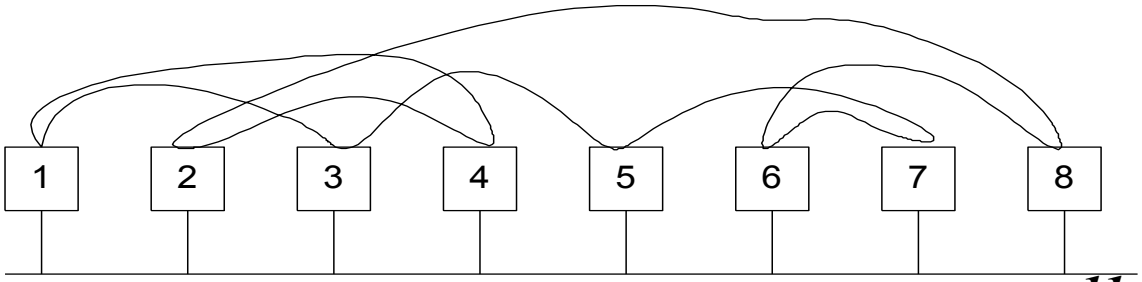
IEEE Standard 802.4

Need a mechanism to handle real-time, deterministic requirements.
802.3 could contend forever and this is often not acceptable.

A ring, with stations taking turns is deterministic.
Uses logical ring on linear cable.
Mechanism -

- o All stations numbered; station knows # of its neighbors.
- o A token, required in order to send, is initialized by the highest number station.
- o A station, receiving the token, does a send if it has a request, then sends the token to its logical (not necessarily physical) neighbor.

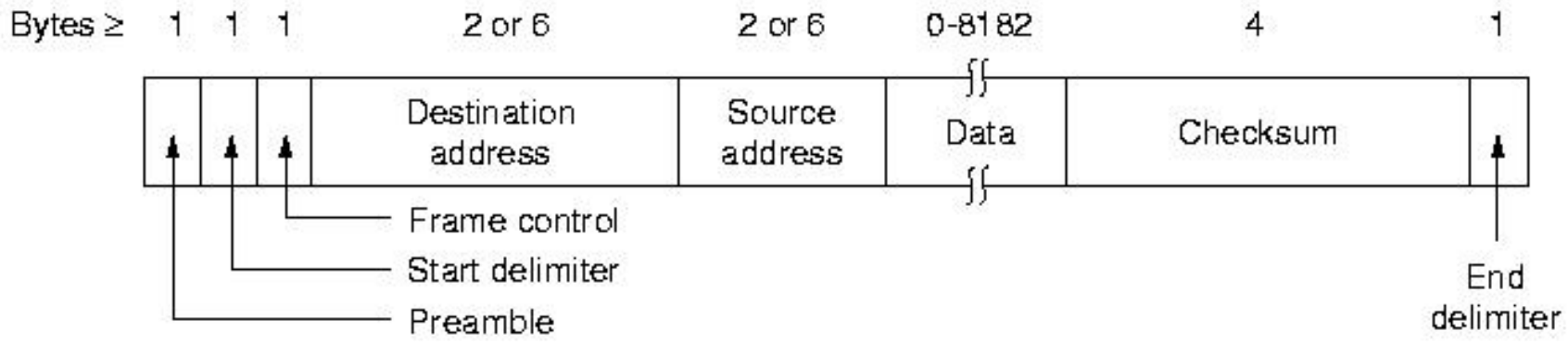
Activation -
o Stations can come and go on the bus, without breaking mechanism.



IEEE Standard 802.4

The frame format. Fields are:

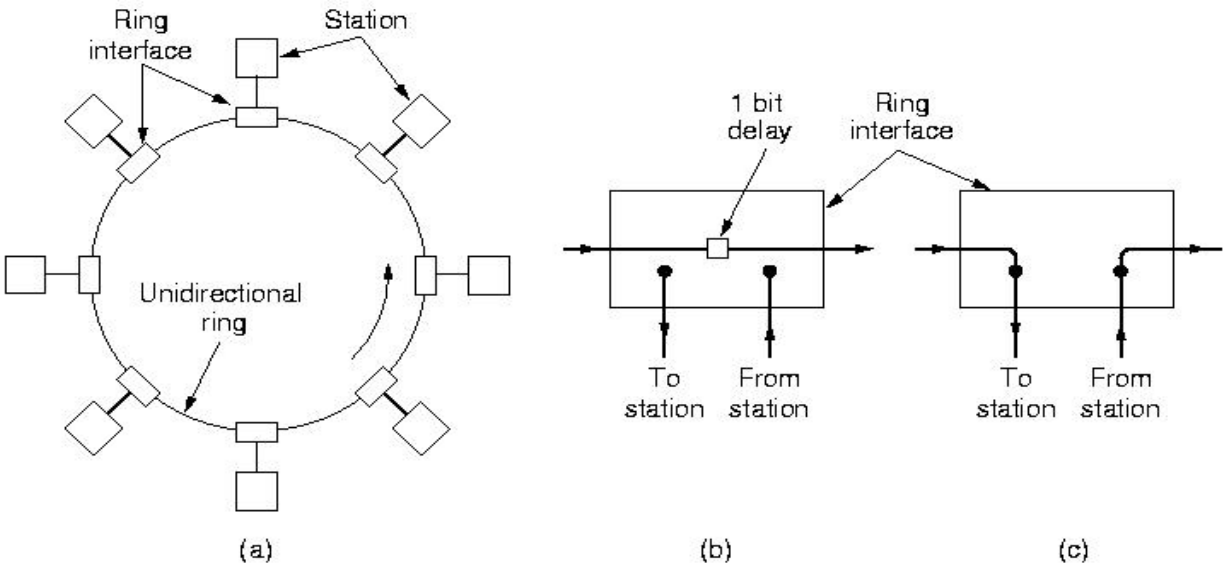
Preamble - used to synchronize receiver clock.
Start/End Delimiter - Indicates start of frame.
Frame control - shows control data.
shows priority of data packets.
flag requiring ACK from receiver.
shows type of control frame (more later).
Destination Address - (same as 802.3) - usually 6 bytes.
Source Address - (same as 802.3) - usually 6 bytes.
Data - BIG - 8182 or 8174 bytes
Checksum - (Same as 802.3)



IEEE Standard 802.5

Stations on a token ring LAN are logically organized in a ring topology with data being transmitted sequentially from one ring station to the next with a control token circulating around the ring controlling access.

- Not broadcast but point to point.
- There is a 1 bit delay at each station. (Trnsamit and Receive Mode)
- Token is 3 bytes. Inverting a bit.
- Frame removed when it comes back.
- No restriction on size of data as long as token holding time does not expires.



IEEE Standard 802.5

TOKEN RING MAC SUBLAYER PROTOCOL:

Frame Structure Components -

SD, ED Delimiters – have encoding so not confused as data.

AC Access control - PPPTMRRR

T - The token bit - flip this bit and it's a data preamble.

M - Monitor bit (Orphan frames)

PPP - Priority bits – Other station can reserve only if high priority data is to sent.

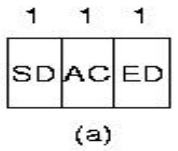
RRR - Reservation bits

Frame control Provides numerous control options. TTIIIIII T – Type I – Information.

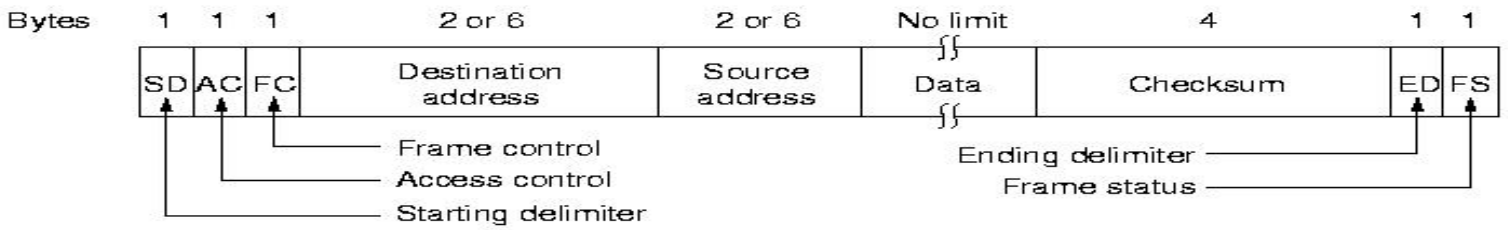
Source/Destination addresses/checksum Same as 802.3 & 802.4

Frame Status ACRRACRR A – Address Recognized C – Frame Copied

RR – Reserved for future use.



(a)



(b)

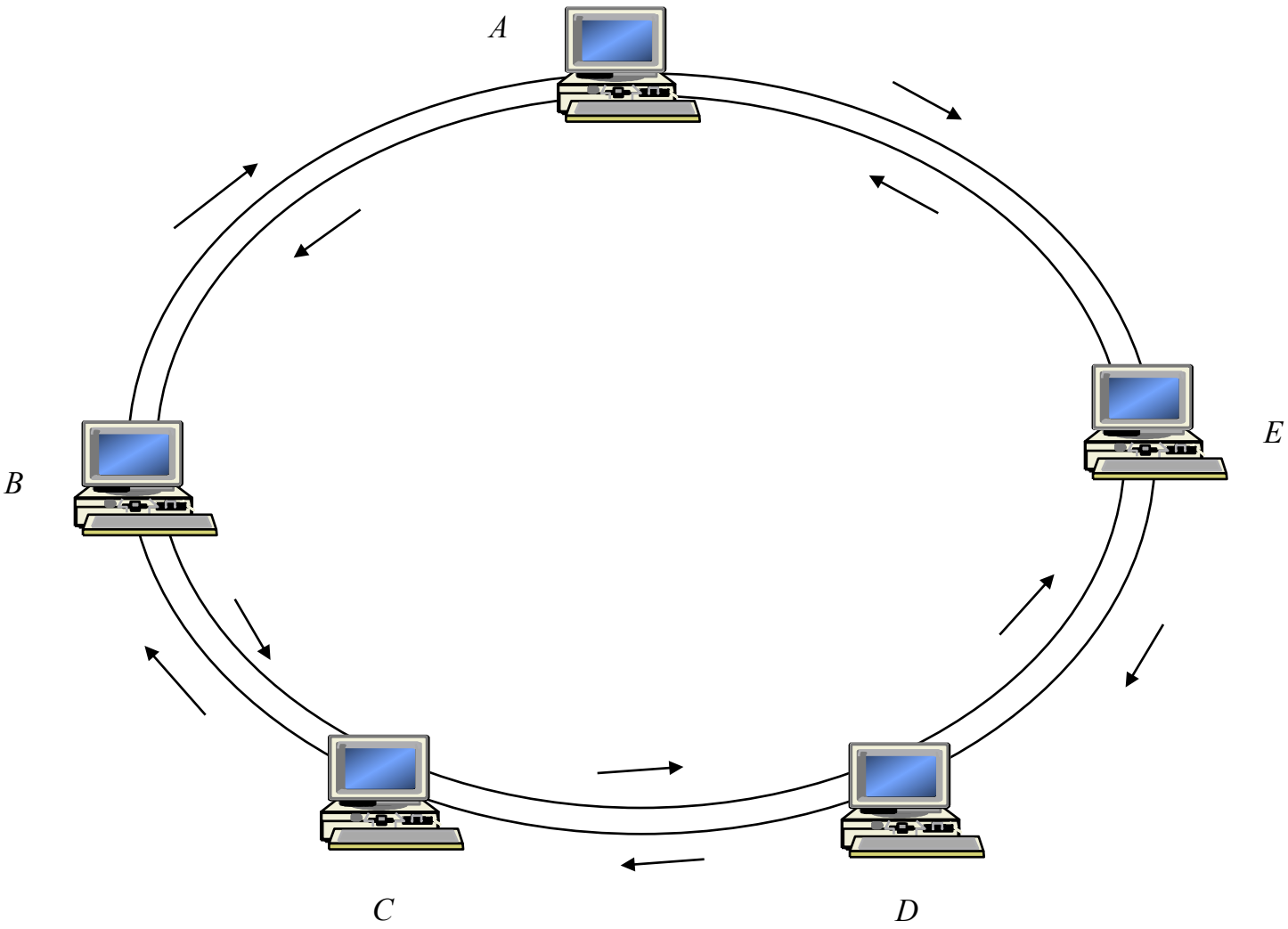
IEEE Standard 802

TOKEN RING MAC SUBLAYER PROTOCOL:

FDDI : Fiber Distributed Data Interface

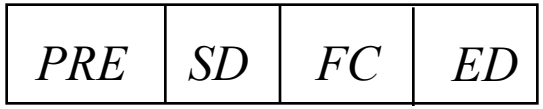
- FDDI is a high speed token ring fiber optical cable based technology.
- This technology can 'self-heal', which means that the hardware can automatically detect and correct hardware problems.
- FDDI consists of two independent rings to connect each computer. Data flows in opposite direction in each ring.
- FDDI can have two types of Network Interface Cards, A and B, that connect to it.
- Class A Network Interface Cards connect to both rings while class B Network Interface Cards connect to only one ring.
- uses a ring topology of multimode or single mode optical fiber transmission links operating at 100 Mbps to span up to 200 kms
- Employs dual counter – rotating ring
- 16 and 48-bit address are allowed
- token is absorbed by station and released as soon as it completes the frame transmission *{multi-token operation}.*
- Maximum of 500 stations.

FDDI – Dual Token Ring

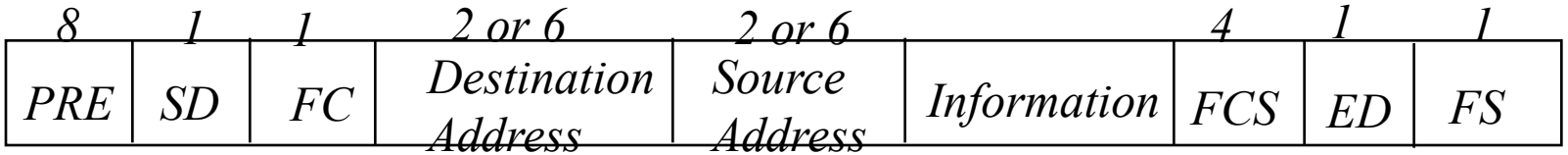


FDDI frame structure

Token Frame Format



Data Frame Format



Preamble

Frame Control *CLFFZZZZ*

C = Synch/Asynch

L = Address length (16 or 48 bits)

FF = LLC/MAC control/reserved frame type

BRIDGES

Overview

This is one way that networks are connected together.

Bridges operate in the data link layer, and so don't have the intelligence to do much address resolution.

Main Purpose :

Translation from one LAN type to another. Given a MAC address, how does a packet get to its destination.

BRIDGES

Hub or repeater just electronic amplification.

Bridges operate with active Data Link Layer. Can convert between different physical/ data link types. Way to connect multiple LANs.

Routers operate at Network layer - they read and depend on a specific protocol.

Protocol Converters are able to convert from one network layer type to another.

Why to have multiple LANs :

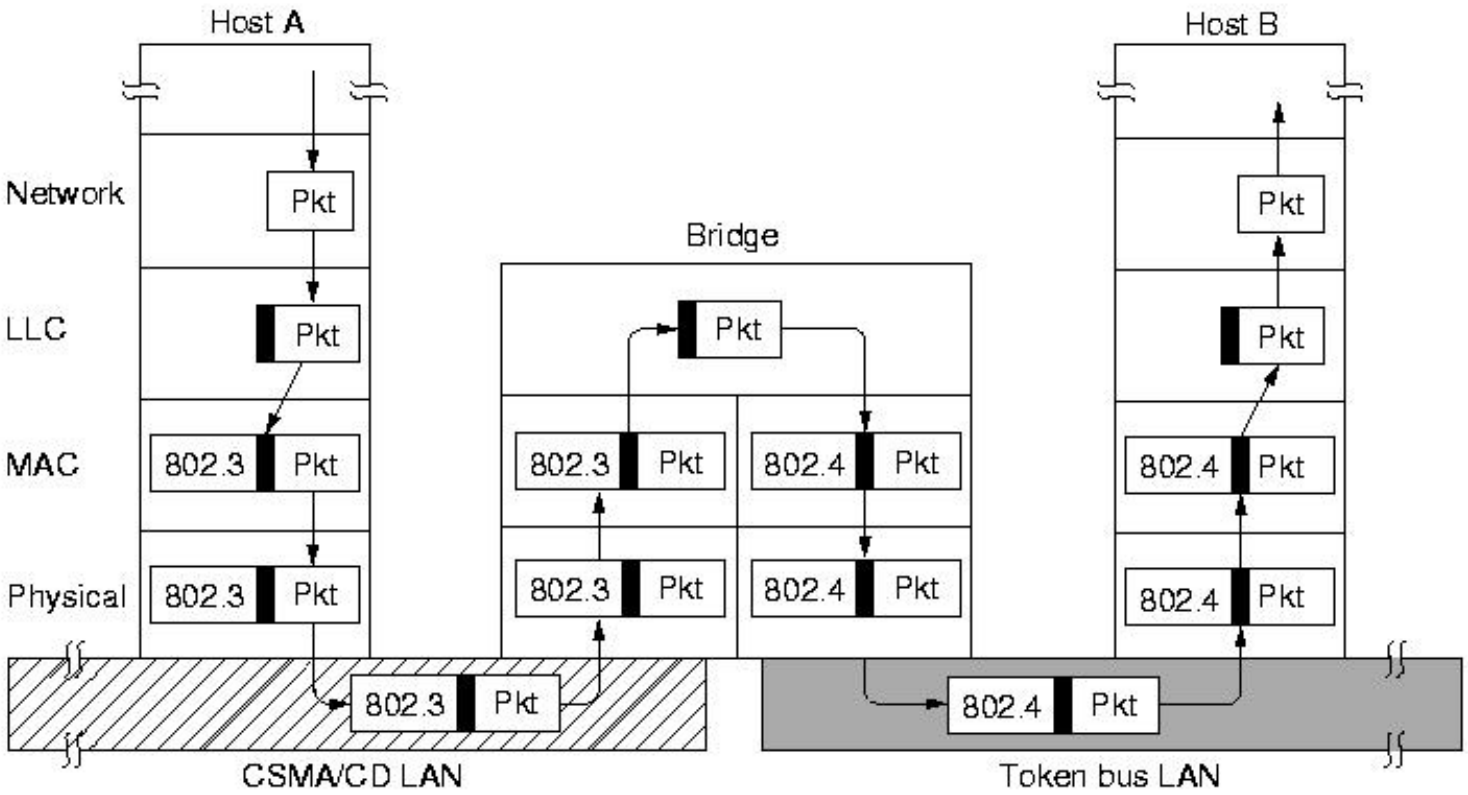
Organizations have different LANs (802.3/4/5) to meet various needs.

- Cost - may make the cabling less expensive.
- To carry a combined load heavier than any one LAN could do.
- Total distance more than 2.5 Km.
- Bridges can act as firewalls, to partition against errant hardware.
- LANs broadcast everything on the LAN to all stations. May want to prevent this from happening for some data. A bridge partitions off these messages.

BRIDGES

The Big Picture

How they work -



BRIDGES

TRANSPARENT BRIDGES
SPANNING TREE BRIDGES
SOURCE ROUTING BRIDGES