

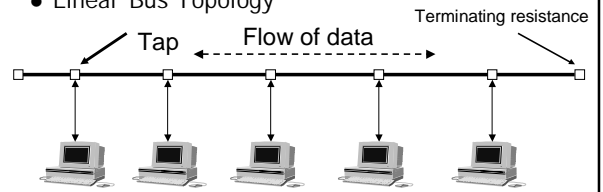
LAN Topology (Cont.)

Introduction

1

Bus Topology

- Linear Bus Topology



2

Bus Topology

- Design Issues:

- ❖ Channel multiplexing
- ❖ Signal balancing: the signal strength must be adjusted to be within certain limits
- ❖ Transmission medium
 - ✓ Coaxial Cable
 - Broadband
 - Baseband
- ❖ Data rate
- ❖ Cable length
- ❖ Number of taps

3

Bus Topology (Cont.)

- Baseband Coaxial cable

- ❖ Original usage was the Ethernet at 10Mbps
- ❖ Digital Signaling
- ❖ Bidirectional transmission
- ❖ All frequency spectrum is consumed (I.e. no multiple channels)
- ❖ Cannot easily propagate through branching points
- ❖ Suffering attenuation

- Consequences:

- ❖ Limited distance (~ 1km)
- ❖ Suitable for bus but not for tree

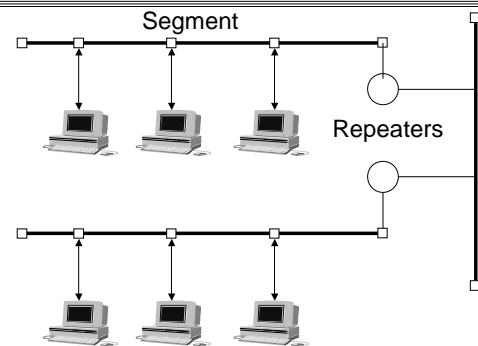
4

Bus Topology (Cont.)

| | 10BASE5 | 10BASE2 |
|------------------------|---------|---------|
| Data rate | 10 Mbps | 10 Mbps |
| Maximum segment length | 500 m | 185 m |
| Network span | 2500 m | 1000 m |
| Nodes per segment | 100 | 30 |
| Node spacing | 2.5 m | 0.5 m |
| Cable diameter | 1 cm | 0.5 cm |

5

Baseband Configuration



6

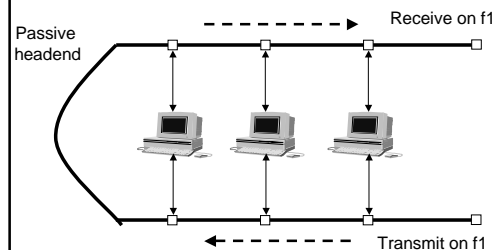
Bus Topology (Cont.)

| Baseband | Broadband |
|-----------------------------------------|--------------------------------------|
| Digital signaling | Analog signaling (requires RF modem) |
| Entire bandwidth consumed by the signal | FDM possible |
| Bidirectional | Unidirectional |
| Bus topology | Bus or tree topology |
| Distance: up to a few kilometers | Distance: up to tens of kilometers |

7

Broadband Coaxial Cable

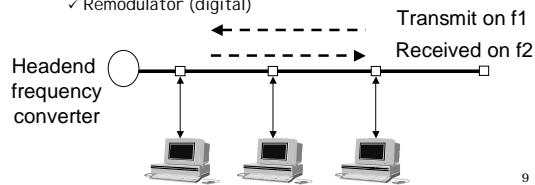
- Dual
 - ❖ Inbound and outbound are separated
 - ❖ Stations send and receive on the same frequency



8

Broadband Coaxial Cable

- Split
 - ❖ Inbound and outbound paths are different frequency bands on the same cable
 - ❖ A frequency converter resides in the headend
 - ✓ Frequency translator (analog)
 - ✓ Remodulator (digital)



9

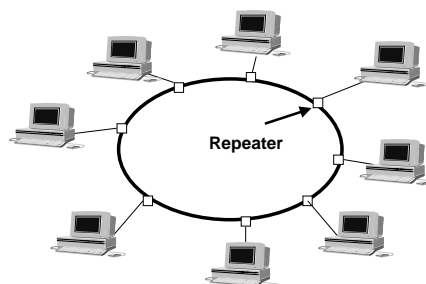
Bus Topology (Cont.)

- Simple and inexpensive
- Limited to short distance (e.g. small office, home, ...)
- IEEE 802.4 Token bus LAN is a robust technology
- Market share is extremely limited

10

Ring Topology

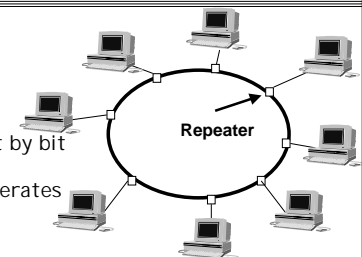
- Ring.



11

Ring Topology (Contd.)

- Ring Topology
 - » Point-to-point
 - » Data transferred bit by bit
 - » Each repeater regenerates and retransmits



12

Ring Topology (Contd.)

- Three required Functions:
 - » Data insertion (when & how)
 - » Data reception
 - » Data removal
 - By addressed repeater
 - By transmitting repeater after one trip around the loop
 - Permits automatic acknowledgment
 - Permits multicast addressing

13

Ring Topology (Contd.)

- Advantages:
 - » Point-to-point communication links
 - Greater distance is covered
 - Can accommodate optical fiber link (i.e. very high speed)
 - » Fault isolation and recovery are simpler than bus/tree
 - Example: duplicate address
 - » Potential throughput
 - » Response time is fairly predictable

14

Ring Topology (Contd.)

- Drawbacks:
 - » The more the devices the longer the delay (sequential broadcast)
 - » Under simple Ring implementation, the network could be completely disabled if one station failed
 - » Perambulation
 - Locating the faulting node (pocket full of keys)

15

Ring Topology (Contd.)

- » Installation
 - Requires the identification of two nearby topologically adjacent repeaters
- » Size limitation
- » Initialization and recovery

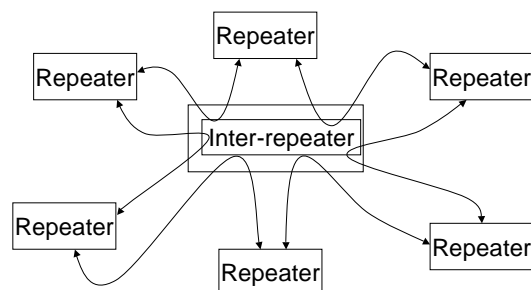
16

Ring Topology (Contd.)

- » Time jitter:
 - the deviation of clock recovery because of the variations of propagation velocity with frequency
 - Intersymbol interference
 - Remedy:
 - Including Phase-lock-loop (PLL) at each repeater
 - Places limitation on # of repeaters (few hundred repeaters)

17

Star-Ring Architecture



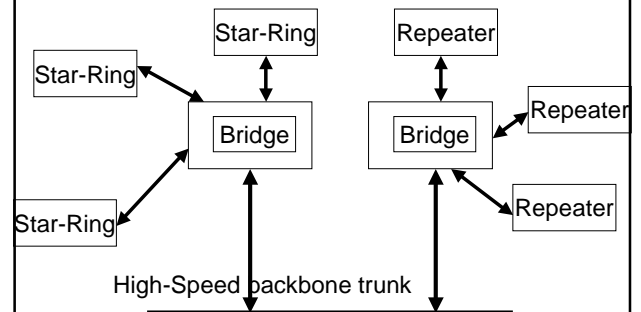
18

Ring Topology (Contd.)

- Star-Ring Architecture:
 - » To solve the vulnerability problem of Ring topology
 - » Key design element is the "inter-repeater" that links all threads through a single site
 - » Solves the perambulation and installation problems

19

Ring-Bridge Architecture



20

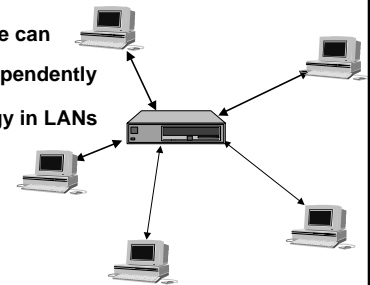
RING-STAR

- Loss of automatic acknowledgment
- Not much expected in terms of performance improvement

21

Star Topology

- Each networked device can access the media independently
- The dominant topology in LANs
 - Scalable
 - Flexible
 - Relatively inexpensive



22

Star Topology (Cont.)

- **Functions of central Hub**
 - Store-and-Forward
 - Broadcasting

23

LAN Switching Techniques

- Store-and-Forward
 - » How does it work?
 - » (Low error rate, long delay) WHY?
- Cut-through switch
 - » Read the destination address from the MAC header
 - » Repeat the incoming frames onto the intended station
 - » (Higher error rate, low delay) WHY?
- In practice, both schemes are applied

24

Star Topology (Cont.)

- Twisted Pair and Optical Fiber
 - » Coaxial cable VS. twisted pair
 - Superior performance
 - Comparable cost of installation
 - » HOWEVER:
 - Unshielded twisted pair installations already exist
 - Make twisted pair more favorable than Coaxial cables
 - » Maximum link is limited to 100m
 - » Or by using Optical Fiber, maximum limit is 500m

25

Star Topology (Cont.)

- Multiple levels of hubs can be cascaded in a hierarchical configuration
- Fits well with building wiring practices
- Each hub could serve a floor
- Hub's functionality:
 - » Incoming signals for upward will be repeated to all lower levels
 - » Incoming signals from below will be repeated to the next higher levels

26

Star Topology: Technical problems

- Building wiring can be inadequate for data transmission (not twisted, splicing, ..) especially at high data rate such as 10 Mbps and higher
- Tightly packed twisted pairs in conduits cause adversely affect attenuation due to mutual capacitance, crosstalk, ...

27

Hubs and Switches

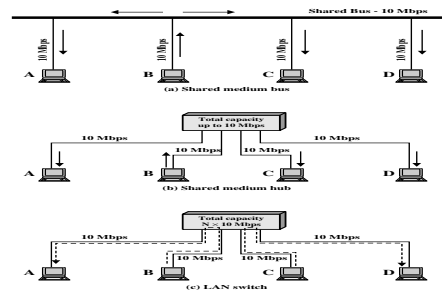


Figure 4.14 LAN Hubs and Switches

28

LAN Switch Features

- No change is required for the software or hardware of the attached device
- Each attached device has a dedicated capacity equal to that of the entire original LAN
- Scalability

29

LAN Topologies (Contd.)

| BUS | RING | STAR |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> ✓ Economical, simple, reliable, easy to work with ✓ Network slows with traffic ✓ Cable break can bring many users down | <ul style="list-style-type: none"> ✓ Equal access to and even performance of all computers. ✓ Failure of one computer can impact entire network | <ul style="list-style-type: none"> ✓ Its centralized management allows for easy growth ✓ Failure of one computer does not affect the remainder of the network ✓ Hub in the star provides central point of failure |

30