Fiber Distributed Data Interface

Introduction

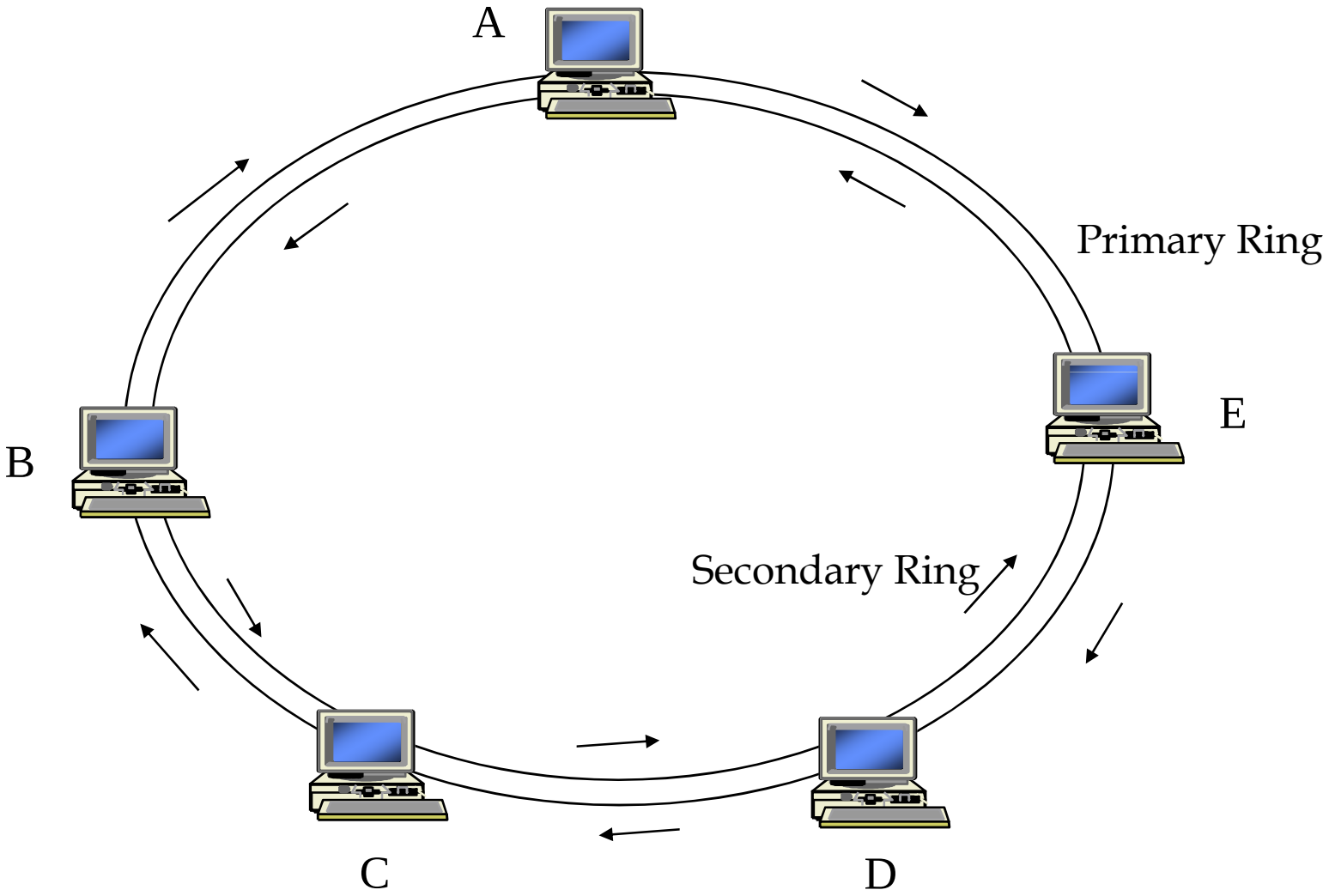
FDDI uses a ring topology for fiber optic cable

Transmission links operates at 100 Mbps(Data rate) to span up to 200 kms and permits up to 500 stations

FDDI uses 4b/5b NRZI (Non-Return to Zero Invert on ones) with 125 Mb/s baud rate to achieve 100 Mb/s data rate

CDDI is used with copper cable

Access Method



Access Method

Dual Ring

- 2 independent rings transmitting data in opposite direction
- When primary link fails the secondary ring is used

Frames flow in one direction: upstream to downstream

Special bit pattern (token) rotates around ring

Must capture token before transmitting

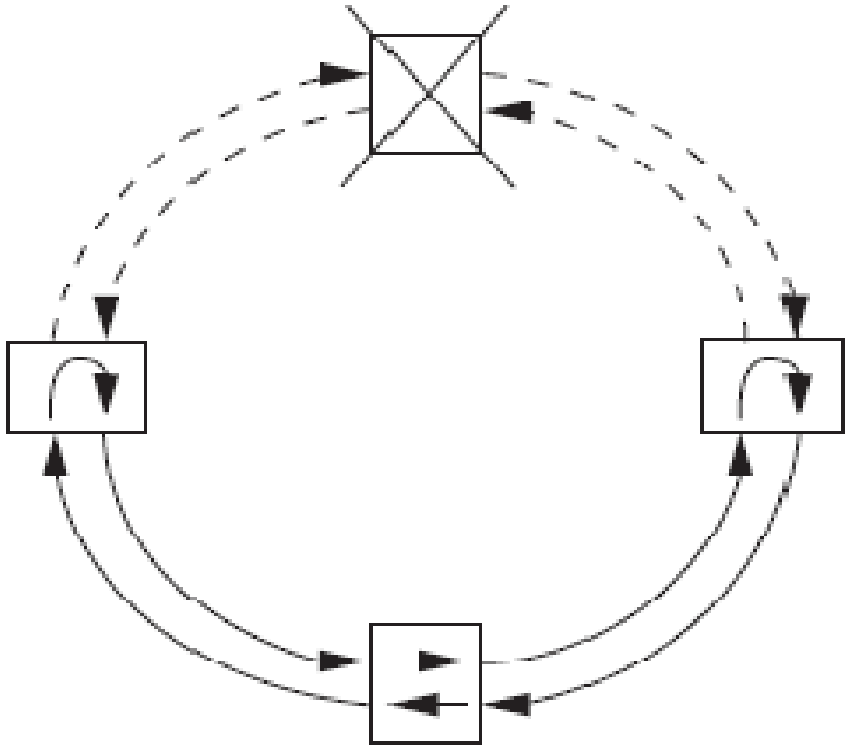
Release token after done transmitting

- Immediate release
- Delayed release

Remove the frame when it comes back to the sender

Stations get round-robin service

Failure of Primary Link



Access Method

The access to a station is limited by time.

A station can transmit any number of frames in its allocated time

2 types of frames

- S Frames (Synchronous – Real time data)
- A Frames (Asynchronous – Non real time data)

Priority is given to real time data. Therefore S frames are transmitted first.

A station captures the token, then transmit S-frames

Any remaining time may then be used to transmit A-frames

S frames/ traffic is delay sensitive

Time Registers

3 Types

- Synchronous allocation (SA)
- Target token rotation time (TTRT)
- Absolute maximum time (AMT)

Used to control the circulation of token and provide equal link access to the nodes.

During the initialization of ring the value of registers are set

Time Registers

Synchronous Allocation (SA)

- Length of time allowed for transmitting S-frames
- Different SA values for each station

Target Token Rotation Time (TTRT)

- Average time required for a token to circulate around the ring exactly once

Absolute Maximum Time (AMT)

- Twice the TTRT ie. AMT = 2 x TTRT
- A token should complete its one rotation within the AMT specified.
- To avoid monopolizing the network

Timers

Each station contains a set of timers that enable comparing actual timing with the register values.

Timers are set/ rest, their values are incremented / decremented at the rate set by system clock

2 Types of Times

- Token Rotation Timer (TRT)
- Token Holding Timer (THT)

Timers

Token Rotation Timer (TRT)

- Runs continuously
- Measures the actual time taken by the token to complete a cycle
- Incrementing or (decrementing) TRT

Token Holding Timer (THT)

- Begins running as soon as the token is received
- Shows how much time remains for sending asynchronous frames
- Decrementing or (incrementing) THT

Station Procedure

When a token arrives, each station does the following:

1. Set the values of timers
   a. THT = TTRT – TRT
   b. TRT = 0

2. Sends synchronous data

3. Sends asynchronous data as long as the value of THT is positive

Measurement of (TRT)

No monitor station. Instead all stations participate in maintaining the ring.

Time between successive token arrival is measured by a node.

TRT > TTRT

Token late, station does not transmit data

TRT < TTRT

Station holds token until TTRT

Token is early so OK to send data

Token Maintenance

- Lost Token
  - No token when initializing ring
  - Bit error corrupts token pattern
  - Node holding token crashes
- Generating a Token (and agreeing on TTRT)
  - Execute when join ring or suspect a failure
  - Each node sends a special *claim frame* that includes the node's *bid* for the TTRT
  - When receive claim frame, update bid and forward
  - If the *claim frame* makes it all the way around the ring:
    - The bid was the lowest
    - All knows TTRT
    - Insert a new token

Monitoring for a Valid Token

All nodes should see valid transmission (frame or token) periodically

Maximum gap between frames = ring latency + max frame <= 2.5ms

Set timer at 2.5ms and send claim frame.

Electrical Specification

FDDI uses a special encoding mechanism called four bits/five bits (4B/5B).

Each four-bit segment of data is replaced by five-bit code before being encoded in NRZ-I.

No more than 2 consecutive 0's present in the encoded data

4B/5B Encoding

Data	Code
0000	11110
0001	01001
0010	10100
0011	10101
0100	01010
0101	01011
0110	01110
0111	01111

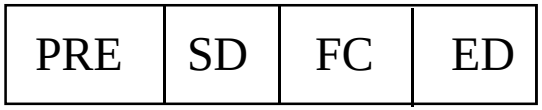
Data	Code
1000	10010
1001	10011
1010	10110
1011	10111
1100	11010
1101	11011
1110	11100
1111	11101

4B/5B Encoding

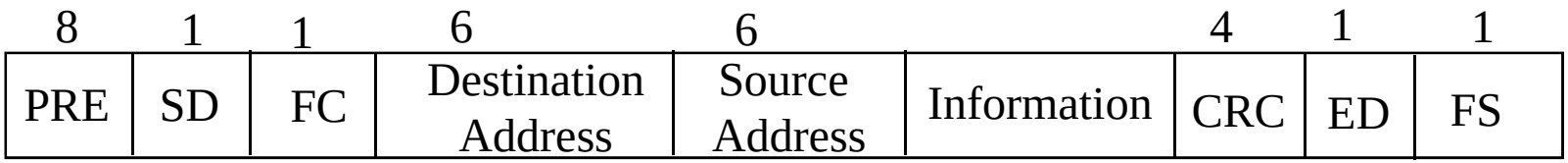
Control Symbol	Encode Sequence
Q(Quite)	00000
I (Idle)	11111
H(Halt)	00100
J (used in start delimiter)	11000
K (used in start delimiter)	10001
T (used in end delimiter)	01101
S (Set)	11001
R (Reset)	00111

FDDI Frame Format

Token Frame Format



Data Frame Format



Preamble

Frame Control C L FF ZZZZ

C = Synch/Asynch
L = Address length (16 or 48 bits)
FF = LLC/MAC control/reserved frame type

FDDI Ring

Expensive – twice the amount of fiber

Nodes can be connected to a ring or both rings using media interface connector (MIC)

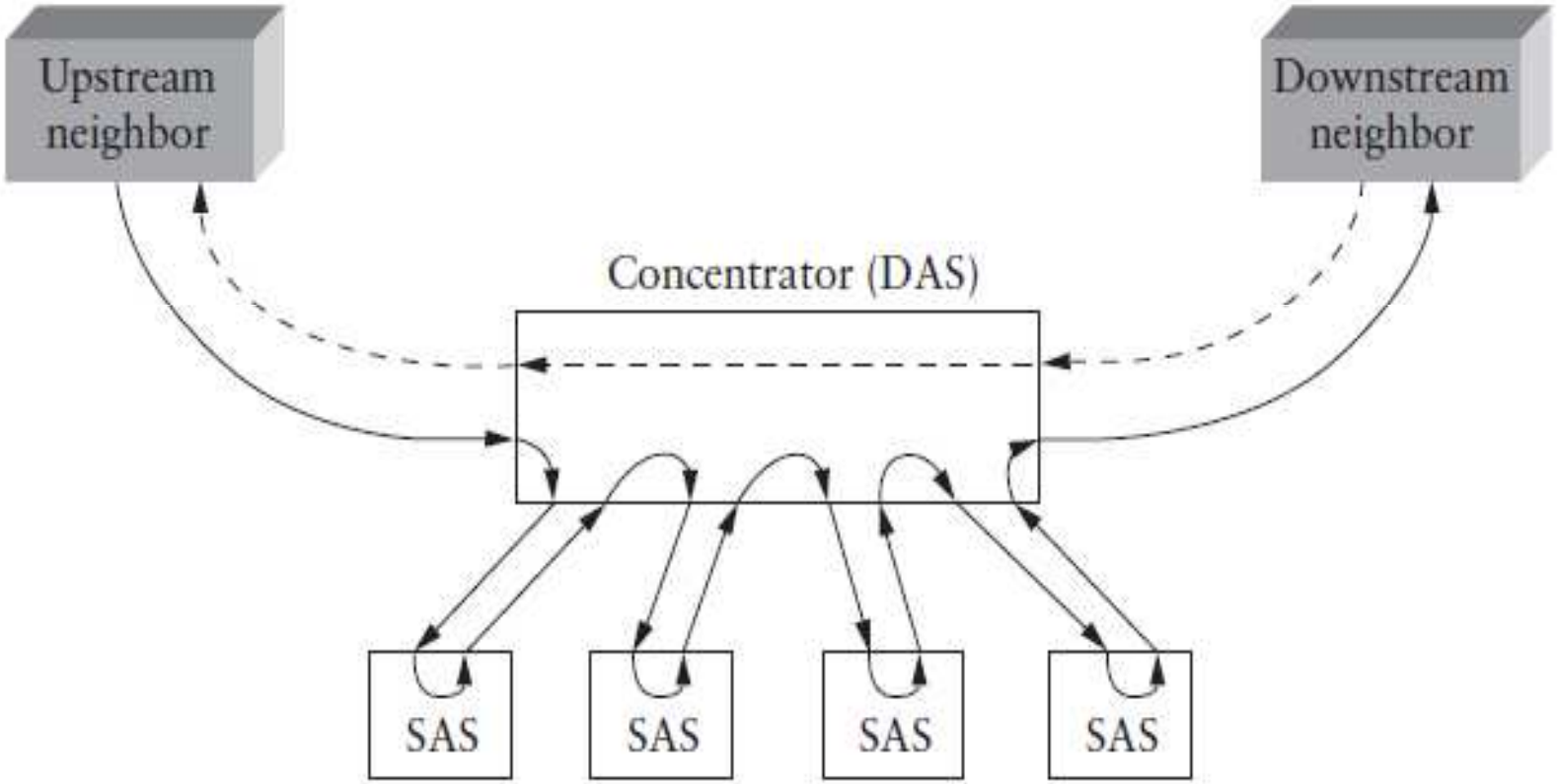
Three Types of Nodes

- SAS – Single Attachment Station
- DAS – Dual Attachment Station
- DAC – Dual Attachment Concentrator

FDDI Ring

- Dual-Attachment Station (DAS)
  - DAS has 2 MIC
  - Connects to both primary and secondary rings
  - Allows the ring to continue to operate even if a break occurs in the line by rerouting through the secondary ring (backwards)
- Single-Attachment Station (SAS)
  - SAS has a single MIC
  - connects only to the primary ring
  - Faulty stations are bypassed to keep the ring alive
- Dual Attachment Concentrator DAC
  - DAC Connects SAS to the dual ring
  - Does control functions

FDDI Ring


Upstream neighbor
Downstream neighbor
Concentrator (DAS)
SAS
SAS
SAS
SAS

Differences b/w 802.5 and FDDI

Token Ring	FDDI
Shielded twisted pair	Optical Fiber
4, 16 Mbps	100 Mbps
No reliability specified	Reliability specified (dual ring)
Differential Manchester	4B/5B encoding
Centralized clock	Distributed clocking
Priority and Reservation bits	Timed Token Rotation Time
Single token operation	Multi-token operation