Optical Communications
Lecture 8

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TIMELINE FOR FDDI

- PROJECT INITIATED IN OCTOBER 1982 BY JAMES HAMSTRA AT SPERRY (NOW UNISYS)
- TWO PROPOSALS FOR MEDIA ACCESS CONTROL (MAC) & PHYSICAL (PHY) LAYERS SUBMITTED IN JUNE 1983
- FDDI MAC BECAME AN ANSI STANDARD IN LATE 1986
- FDDI PHY WON ANSI STANDARDIZATION IN 1988
- FDDI - II PROPOSAL WAS MADE IN EARLY 1986
- FIRST PUBLIC DEMONSTRATIONS AT ADVANCED MICRO DEVICES (AMD) IN 1989

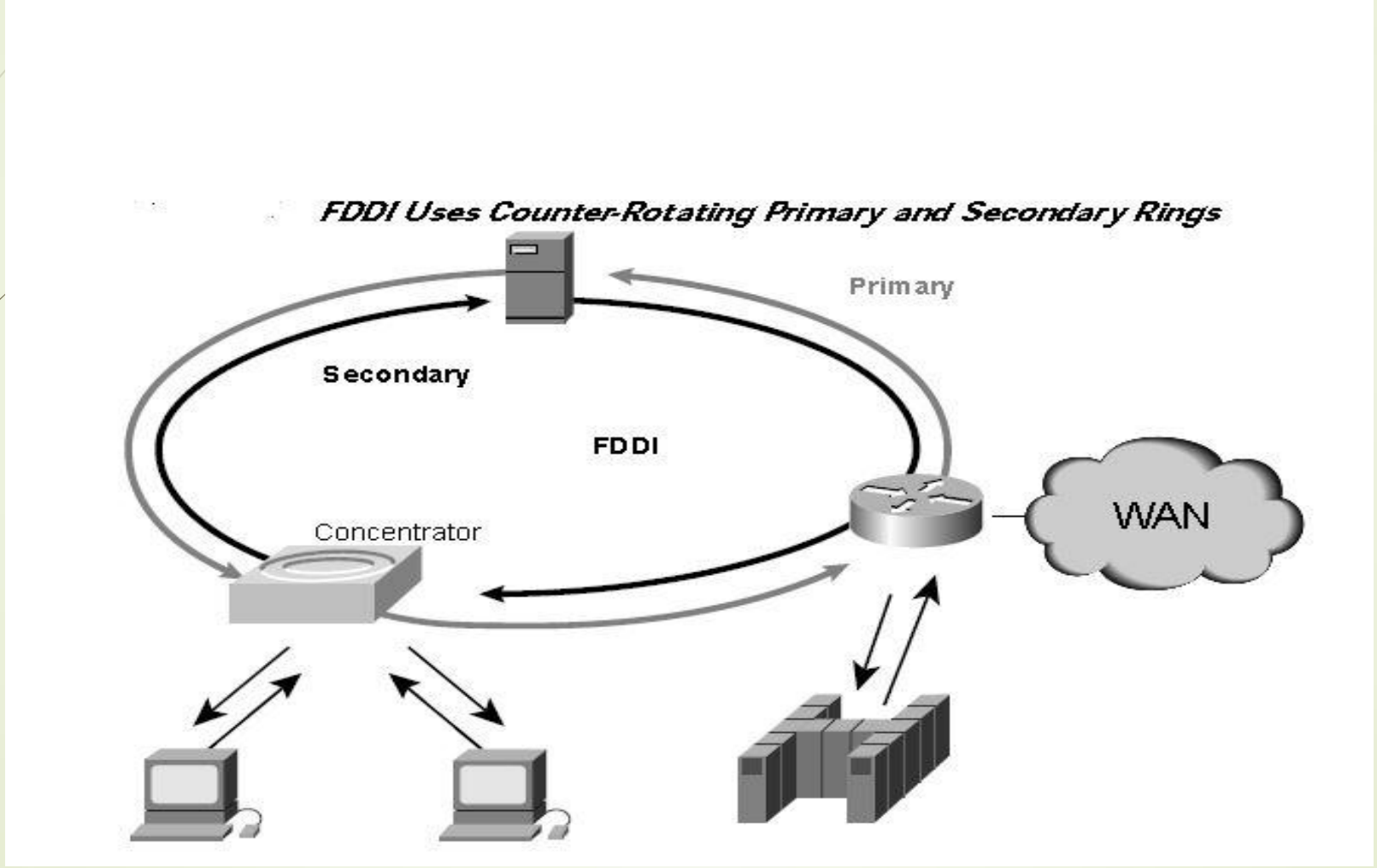
Fiber Distributed Data Interface (FDDI)

- The Fiber Distributed Data Interface (FDDI) specifies a 100-Mbps token-passing, dual-ring LAN using fiber-optic cable.
- It defines the physical layer and media-access portion of the link layer of OSI model.
- FDDI is frequently used as high-speed backbone technology because of its support for high bandwidth and greater distances than copper.
- It operates at faster speeds, FDDI is similar in many ways to Token Ring.

Fiber Distributed Data Interface (FDDI)

- FDDI specifies the use of dual rings. Traffic on these rings travels in opposite directions.
- Physically, the rings consist of two or more point-to-point connections between adjacent stations.
- One of the two FDDI rings is called the primary ring; the other is called the secondary ring.
- The primary ring is used for data transmission, while the secondary ring is generally used as a backup or remains idle.

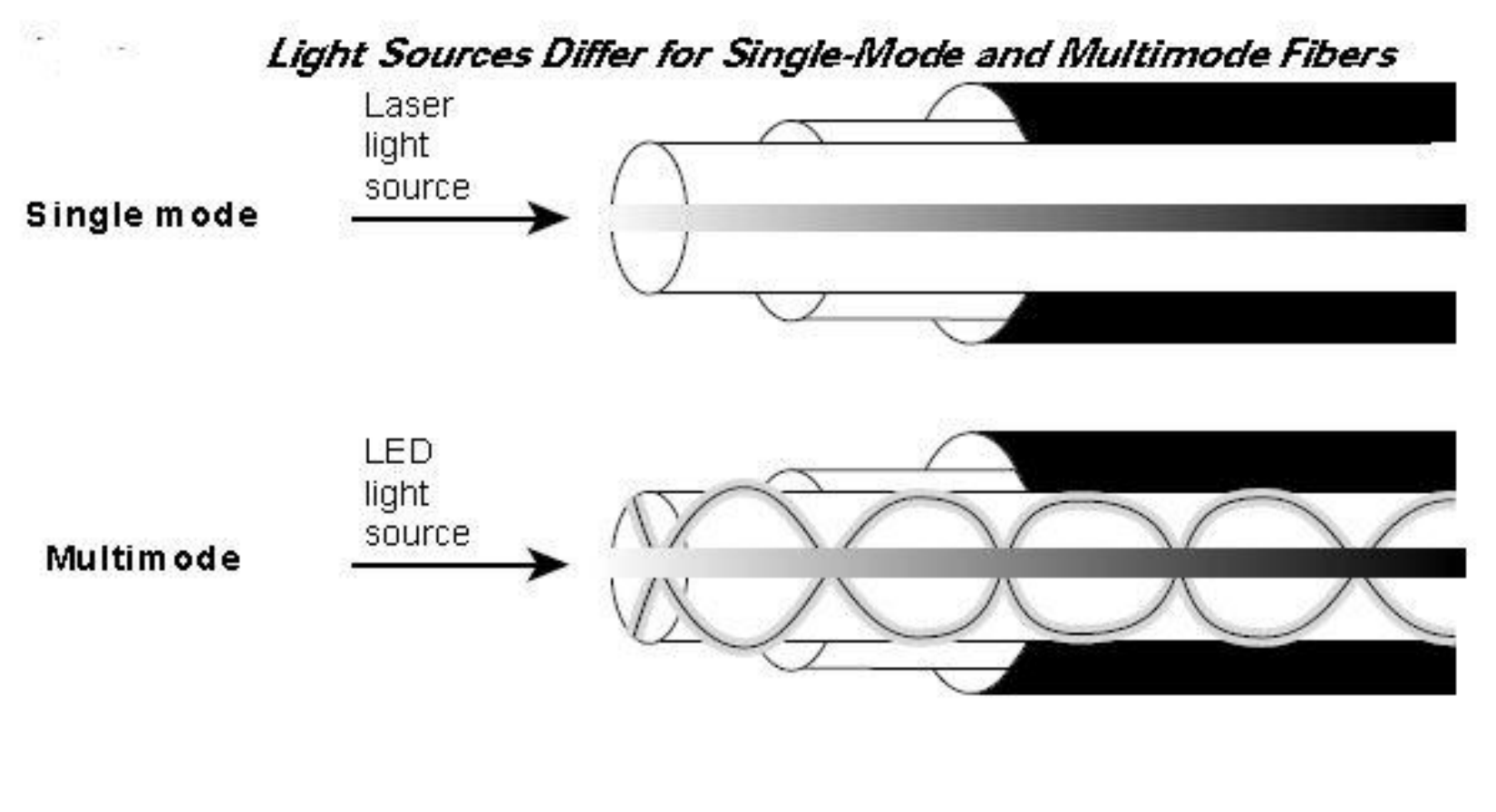
Fiber Distributed Data Interface (FDDI)



Fiber Distributed Data Interface (FDDI)

- FDDI defines use of two types of fiber: single mode and multimode.
- Multimode fiber uses LED as the light-generating device.
- And single-mode fiber generally uses lasers.

Fiber Distributed Data Interface (FDDI)



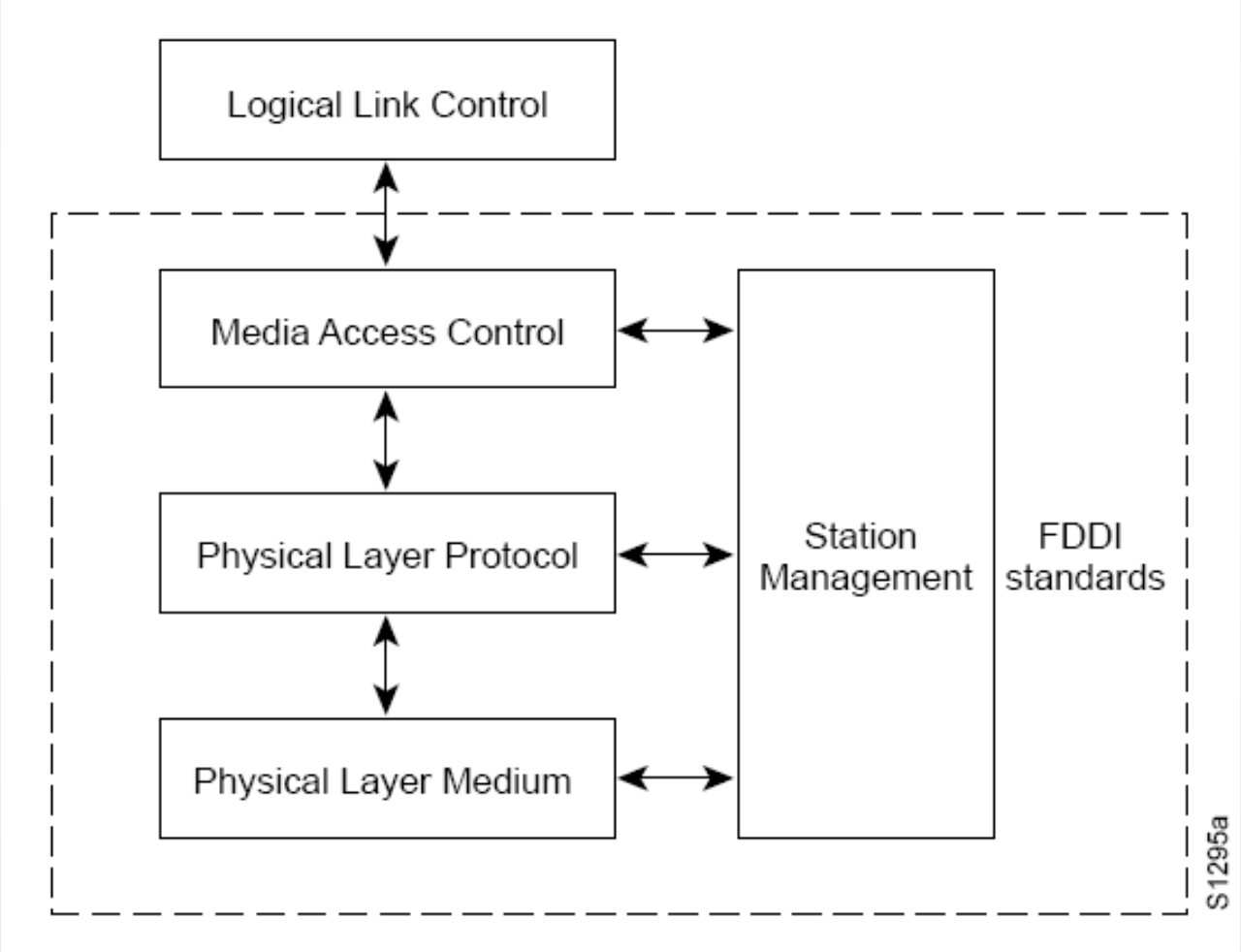
FDDI Specifications

- FDDI is defined by four separate specifications:
- *Media Access Control* (MAC)—Defines how the medium is accessed, including frame format, token handling, addressing, algorithm for calculating a cyclic redundancy check value, and error recovery mechanisms.
- *Physical Layer Protocol* (PHY)—Defines data encoding/decoding procedures, clocking requirements, framing, and other functions.

FDDI Specifications

- *Physical Layer Medium* (PMD)—Defines the characteristics of the transmission medium, including the fiber-optic link, power levels, bit error rates, optical components, and connectors.
- *Station Management* (SMT)—Defines the FDDI station configuration, ring configuration, and ring control features, including station insertion and removal, initialization, fault isolation and recovery, scheduling, and collection of statistics.

FDDI Specifications



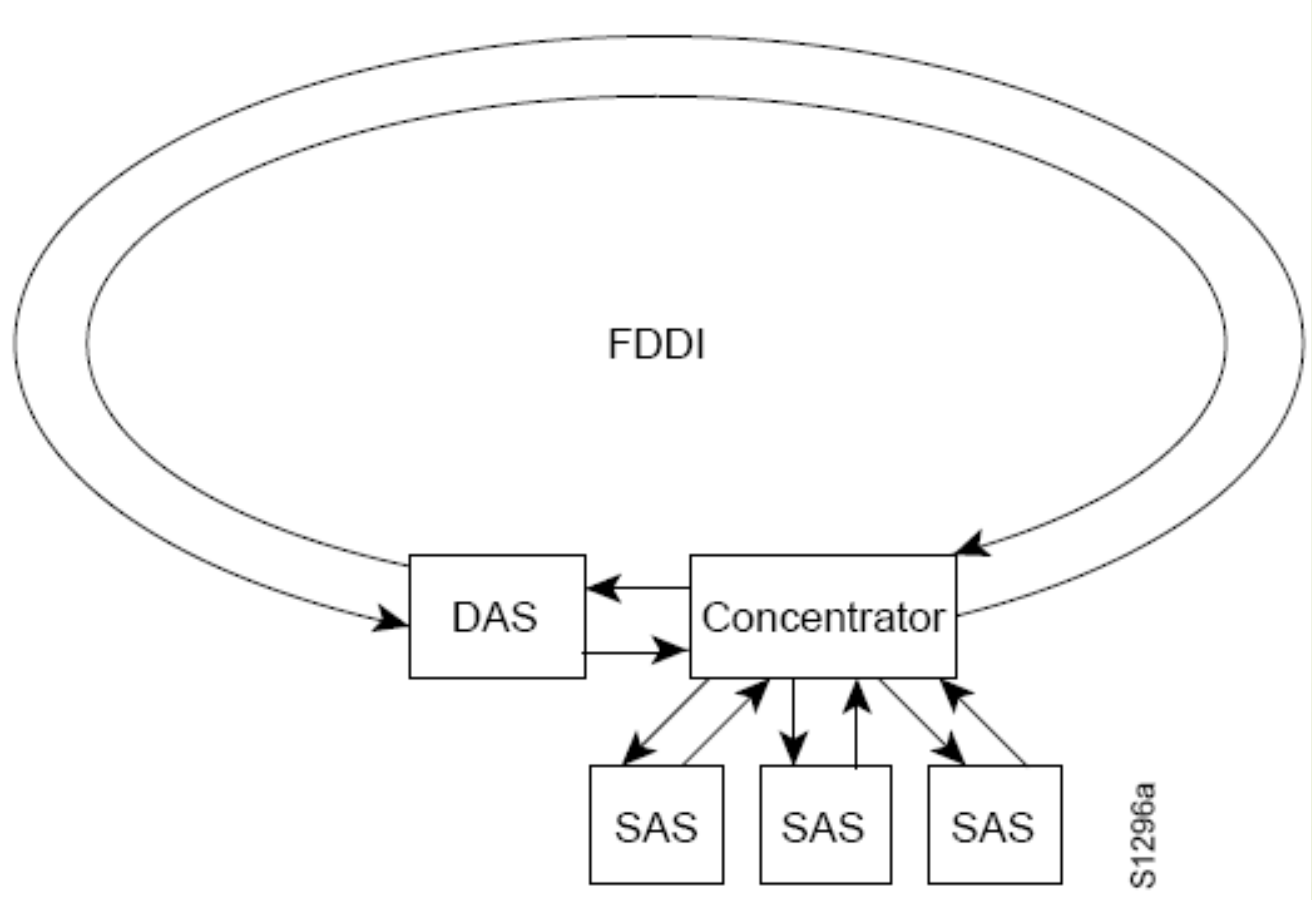
Physical Connections

- FDDI specifies the use of dual rings. Traffic on these rings travels in opposite directions.
- Physically, the rings consist of two or more point-to-point connections between adjacent stations.
- One of the two FDDI rings is called the *primary* ring; the other is called the *secondary* ring.
- The primary ring is used for data transmission, while the secondary ring is generally used as a backup.

Physical Connections

- Class B or single-attachment stations (SAS) attach to one ring; Class A or dual-attachment stations (DAS) attach to both rings.
- SASs are attached to the primary ring through a concentrator, which provides connections for multiple SASs.
- The concentrator ensures that failure or power down of any given SAS does not interrupt the ring.
- This is particularly useful when PCs, or similar devices that frequently power on and off, connect to the ring.

Physical Connections

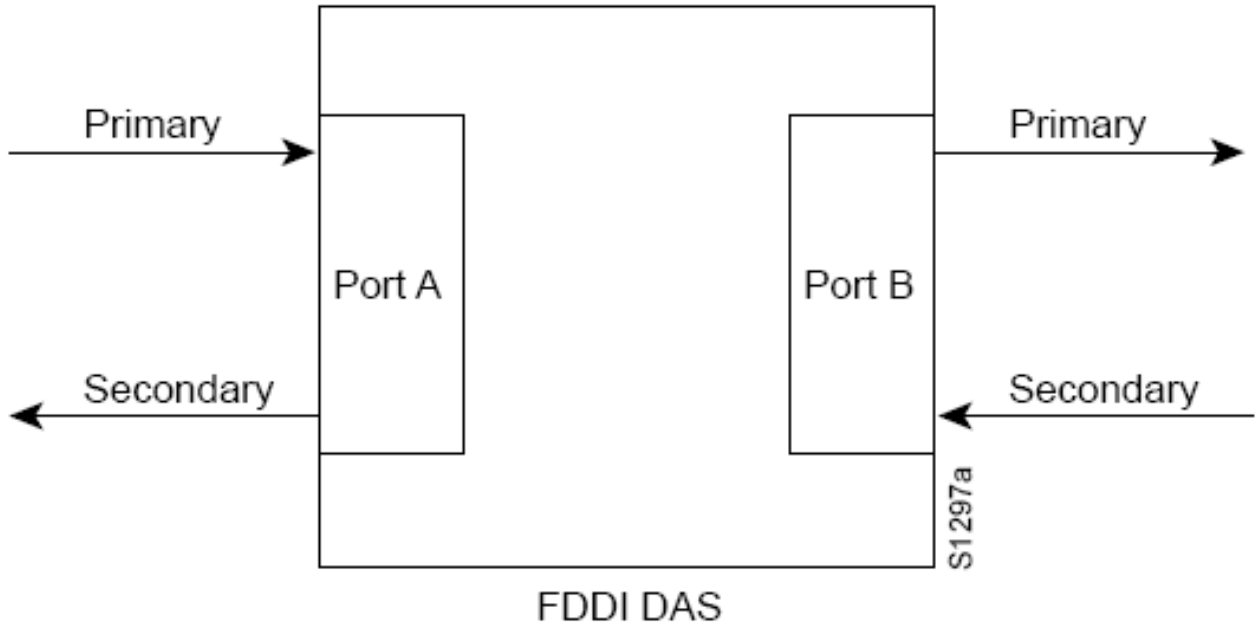


Physical Connections

- Each FDDI DAS has two ports, designated A and B. These ports connect the station to the dual FDDI
- ring. Therefore, each port provides a connection for both the primary and the secondary ring, as shown in Figure.

Physical Connections

Figure 7-3 FDDI DAS Ports



Traffic Types

- FDDI supports real-time allocation of network bandwidth, making it ideal for a variety of different application types.
- FDDI provides this support by defining two types of traffic: *synchronous* and
- *asynchronous*.
- Synchronous traffic can consume a portion of the 100-Mbps total bandwidth of an FDDI network, while asynchronous traffic can consume the rest.

Traffic Types

- Synchronous bandwidth is allocated to those stations requiring continuous transmission capability.
- Such capability is useful for transmitting voice and video information, for example.
- Other stations use the remaining bandwidth asynchronously.
- The FDDI SMT specification defines a distributed bidding scheme to allocate FDDI bandwidth.

Fault-Tolerant Features

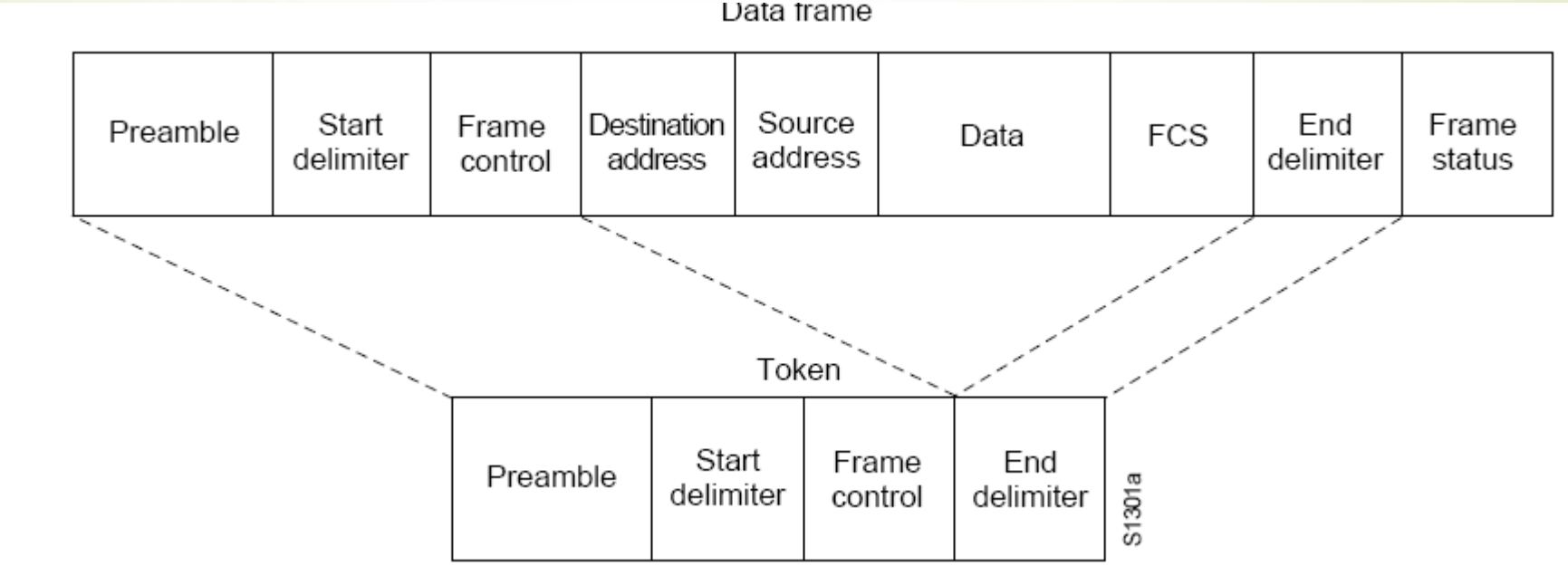
- FDDI provides a number of fault-tolerant features. The primary fault-tolerant feature is the dual ring.
- If a station on the dual ring fails or is powered down or if the cable is damaged, the dual ring is automatically “wrapped” (doubled back onto itself) into a single ring.
- As FDDI networks grow, the possibility of multiple ring failures grows.

Fault-Tolerant Features

- When two ring failures occur, the ring will be wrapped in both cases, effectively segmenting the ring into two separate rings that cannot communicate with each other.
- Subsequent failures cause additional ring segmentation.
- Optical bypass switches can be used to prevent ring segmentation by eliminating failed stations from the ring.

Frame Format

- FDDI frame formats (shown in Figure) are similar to those of Token Ring.



Frame Format

- The fields of an FDDI frame are as follows:
- *Preamble*—Prepares each station for the upcoming frame.
- *Start delimiter*—Indicates the beginning of the frame. It consists of signaling patterns that differentiate it from the rest of the frame.
- *Frame control*—Indicates the size of the address fields, whether the frame contains asynchronous or synchronous data, and other control information.

Frame Format

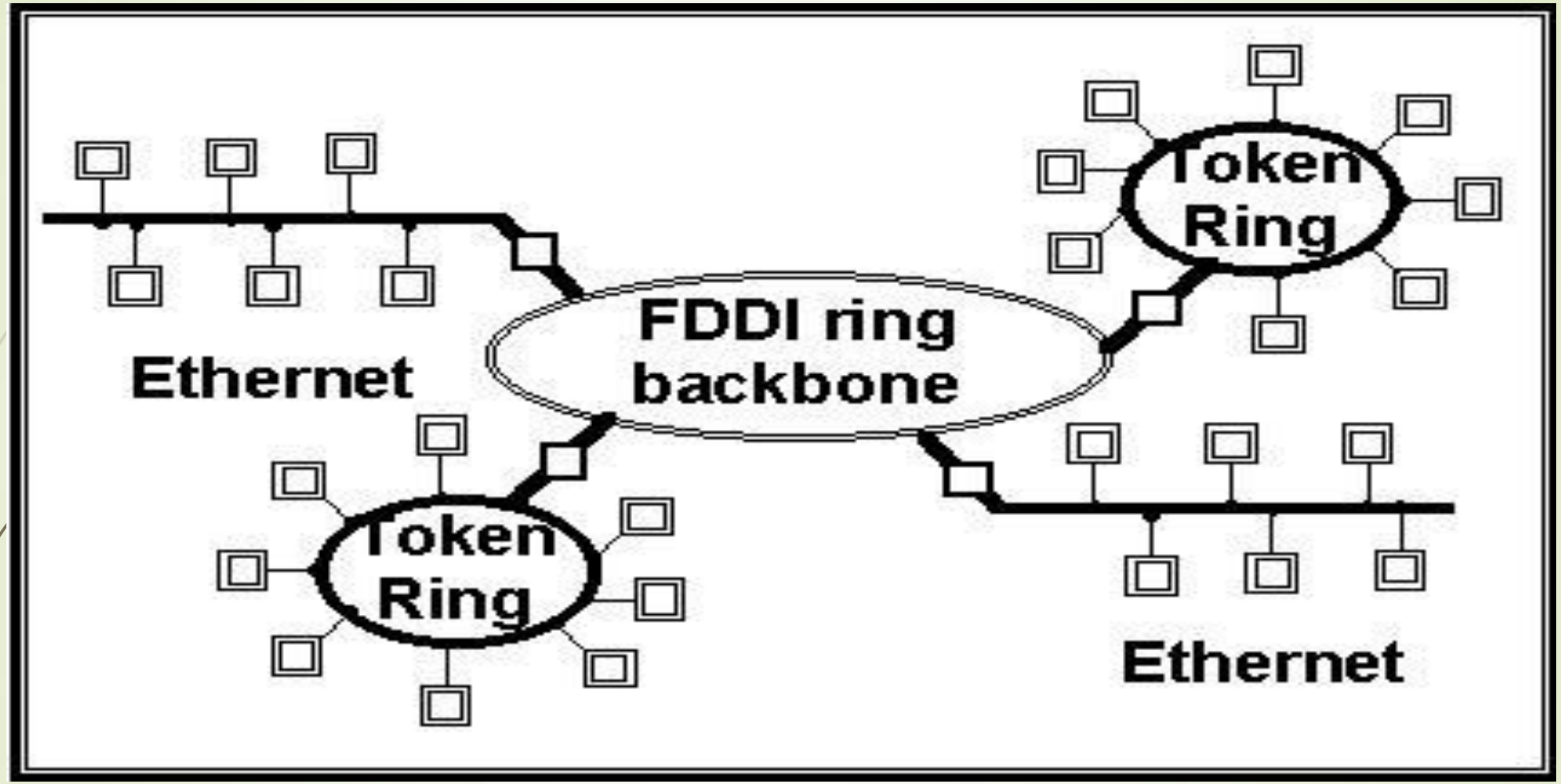
- *Destination address*—Contains a unicast (singular), multicast (group), or broadcast (every station) address. As with Ethernet and Token Ring, FDDI destination addresses are 6 bytes.
- *Source address*—Identifies the single station that sent the frame. As with Ethernet and Token
- Ring, FDDI source addresses are 6bytes.
- *Data*—Contains either information destined for an upper-layer protocol or control information.

Frame Format

- *Frame check sequence* (FCS)—Filled by the source station with a calculated *cyclic redundancy check* (CRC) value dependent on the frame contents (as with Token Ring and Ethernet). The destination station recalculates the value to determine whether the frame may have been damaged in transit. If so, the frame is discarded.
- *End delimiter*—Contains non data symbols that indicate the end of the frame.
- *Frame status*—Allows the source station to determine if an error occurred and if the frame was recognized and copied by a receiving station.

Applications Of FDDI

- Backbone for factory automation.
- Campus LAN interconnection.
- Intercampus backbones or metropolitan area networks (MAN).
- Interconnection of private branch exchanges (PBXs).
- Workgroup and departmental LANs.
- Integrated transport for multimedia applications.



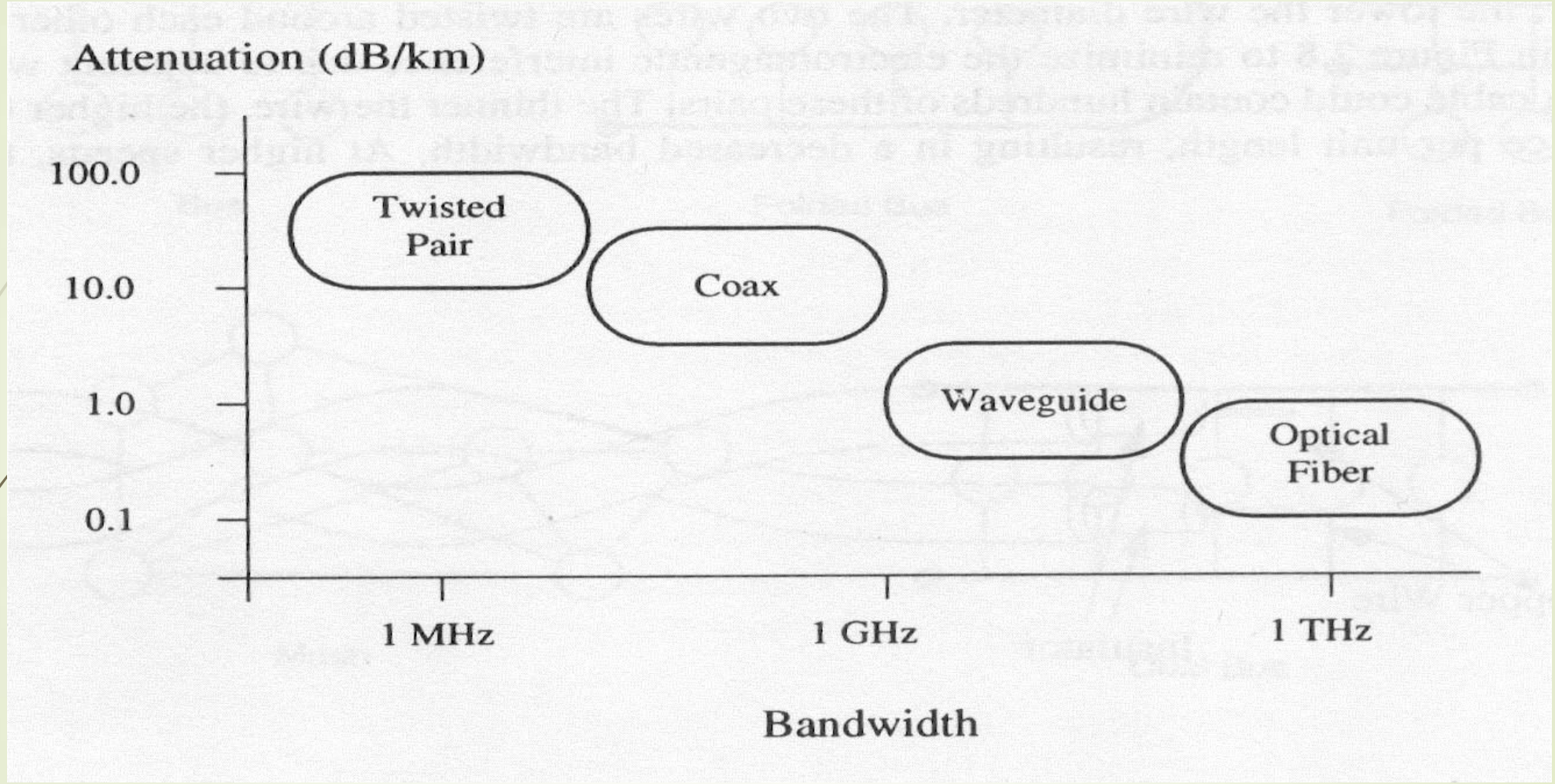
A FDDI BACKBONE NETWORK EXAMPLE

Comparison With Other Networks

FEATURES	FDDI	ETHERNET	TOKEN RING
TRANSMISSION RATE	125 MBAUD	20 MBAUD	8 & 32 MBAUD
DATA RATE	100 MBPS	10 MBPS	4 & 16 MBPS
SIGNAL ENCODING	4B/5B (80% EFFICIENT)	MANCHESTER (50% EFFICIENT)	DIFFERENTIAL MANCHESTER (50% EFFICIENT)
MAXIMUM COVERAGE	100 KM	2.5 KM	CONFIGURATION DEPENDENT
MAXIMUM NODES	500	1024	250
MAXIMUM DISTANCE BETWEEN NODES	2 KM (MULTIMODE FIBER) 40 KM (SINGLE-MODE FIBER)	2.5 KM	300 M (RECOMMENDED 100 M)

FDDI Benefits

- High bandwidth (10 times more than Ethernet).
- Larger distances between FDDI nodes because of very low attenuation (≤ 0.3 DB/KM) in fibers.
- Improves Signal-to-Noise ratio because of no interference from external radio frequencies and noise.
- BER typical of Fiber-Optic Systems (10^-11) is substantially better than that in copper (10^-5) and Microwave Systems(10^-7).
- Very difficult to tap signals from a fiber cable.



COMPARISON OF TRANSMISSION MEDIA

FDDI Limitations

- FDDI is more complex to implement than existing low speed LAN TECHNOLOGIES SUCH AS IEEE 802.3 AND IEEE 802.5 .
- The high cost of fiber-optic cable has been a major impediment to the widespread deployment of FDDI to desktop computers.
- At the same time, shielded twisted-pair (STP) and unshielded twisted-pair (UTP) copper wire is relatively inexpensive and has been widely deployed.
- The implementation of FDDI over copper wire is known as *Copper Distributed Data Interface* (CDDI).

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