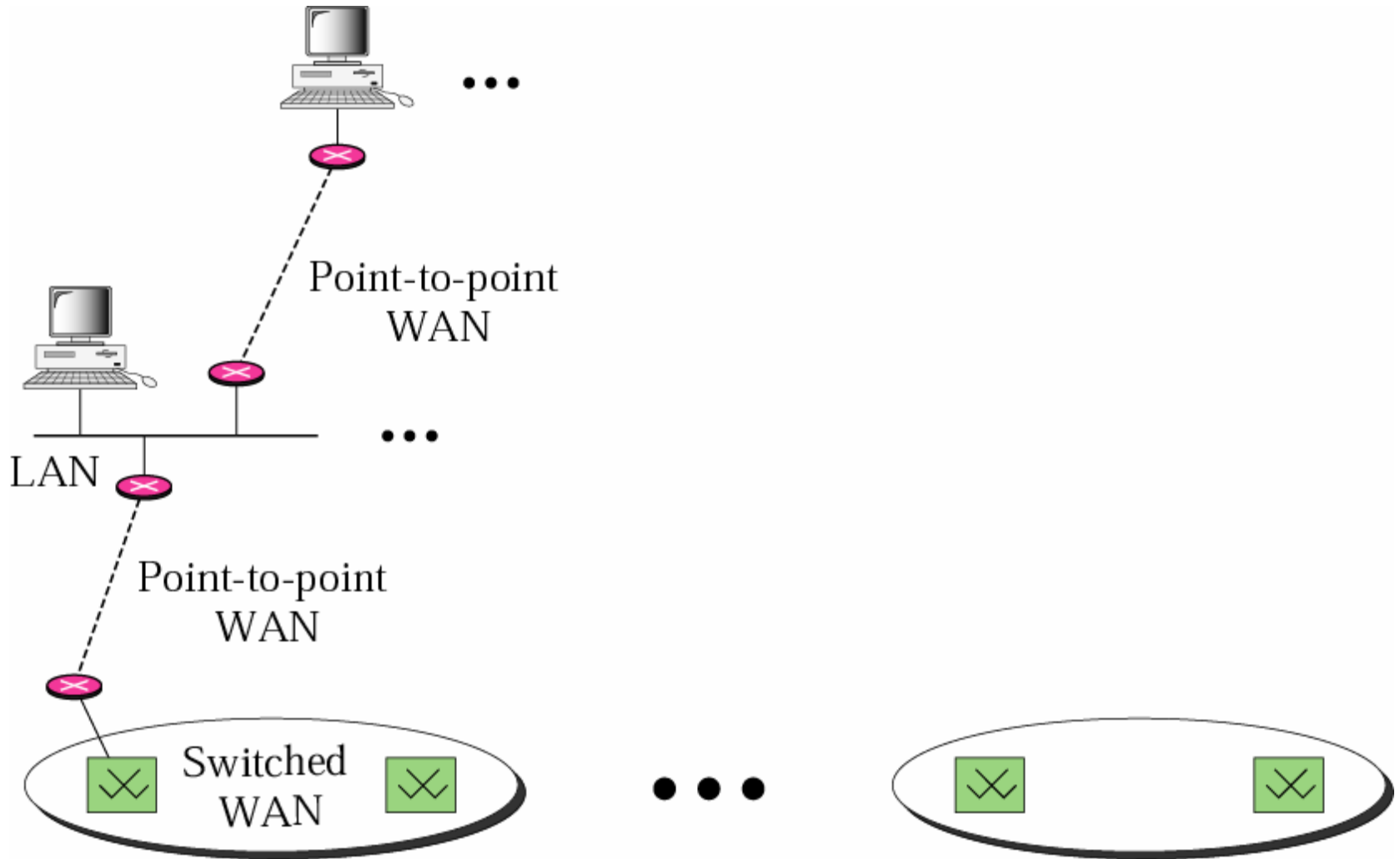Chapter 3

Underlying Technologies

CONTENTS

- **LANS**
- **POINT-TO-POINT WANS**
- **SWITCHED WANS**
- **CONNECTING DEVICES**

Internet model
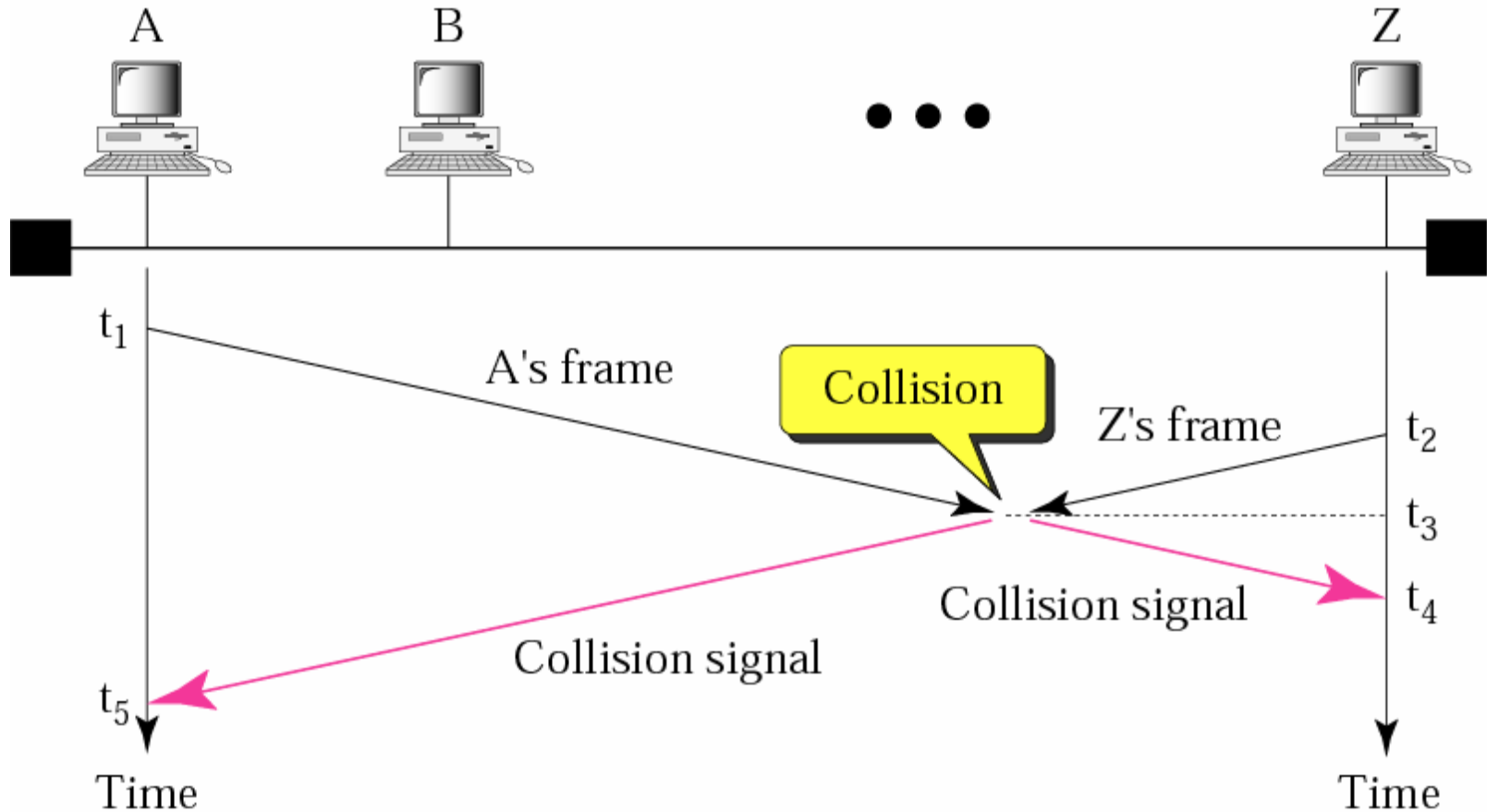
3.1

LOCAL AREA NETWORKS (LANS)

1) Ethernet
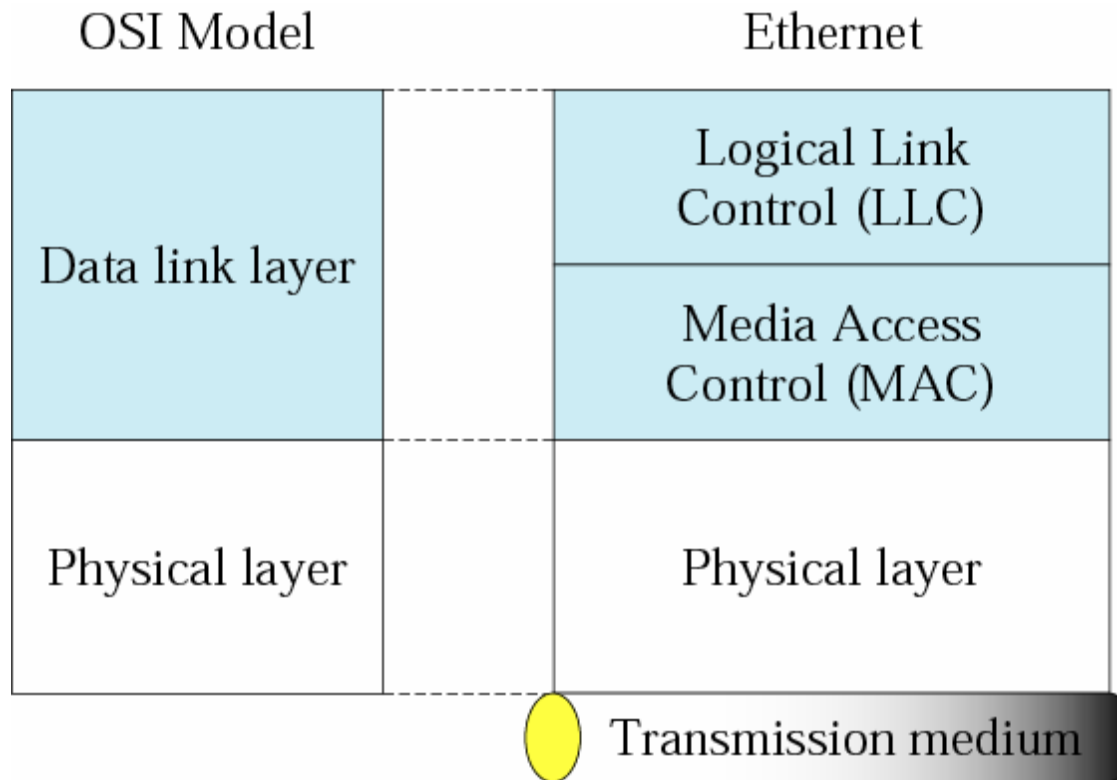**2) Token Ring**
3) Wireless

1) Ethernet and CSMA/CD

To detect collisions:

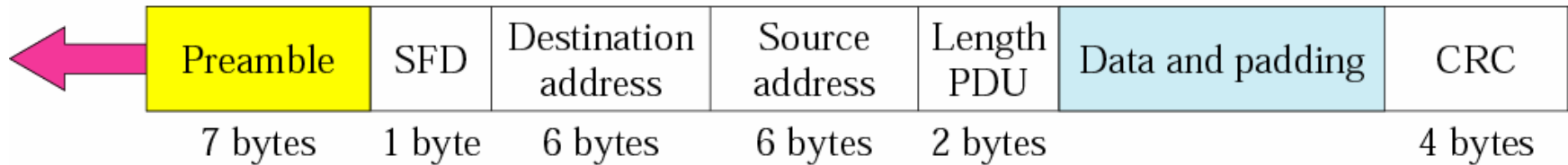**Duration to transmit smallest frame > Time for one bit to travel the entire link**
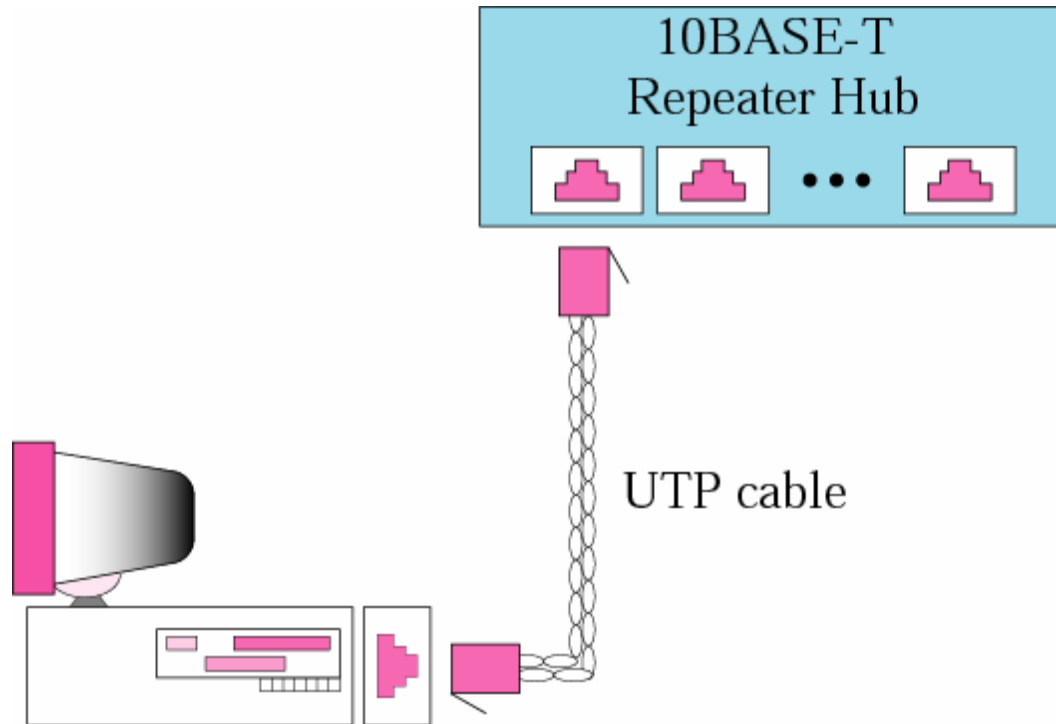
Ethernet layers

OSI Model		Ethernet
Data link layer		Logical Link Control (LLC)
		Media Access Control (MAC)
Physical layer		Physical layer
		Transmission medium

Ethernet frame

Preamble   56 bits of alternating 1s and 0s.
SFD   Start field delimiter, flag (10101011)

| Preamble	SFD	Destination address	Source address	Length PDU	Data and padding	CRC
7 bytes	1 byte	6 bytes	6 bytes	2 bytes		4 bytes

Ethernet implementation

c. 10BASE-T

Fast Ethernet implementation

To Speed up transmission:

Either

1) Increase size of minimum frame, or
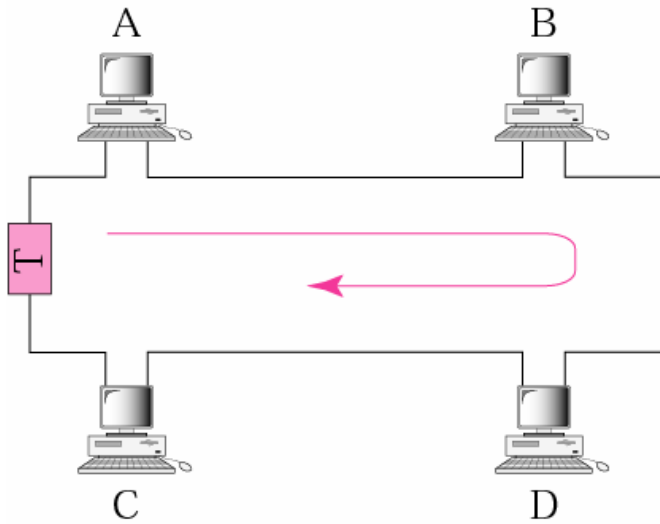
2) Decrease link's length.

100BASE-TX Repeater Hub

Twisted-pair cable

NIC with internal transceiver

a. 100BASE-TX
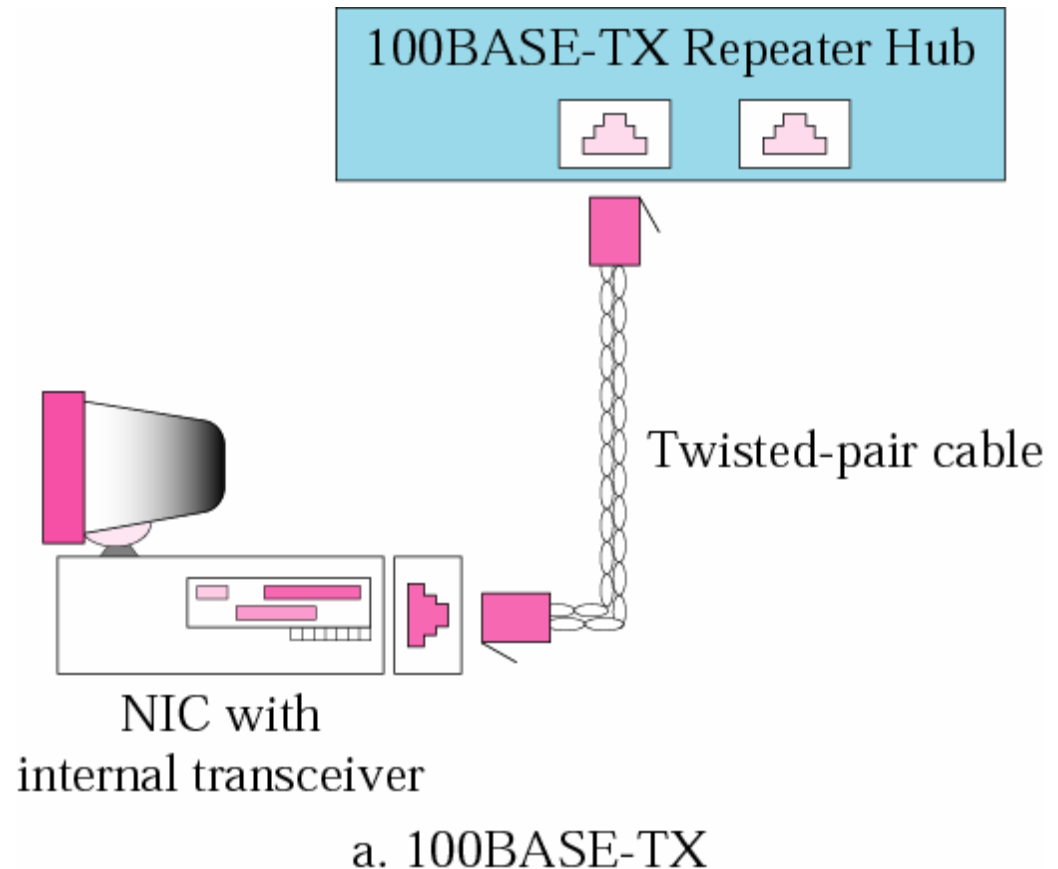
Gigabit Ethernet implementation

To Speed up transmission:

1) *Decrease link's length.*

2) *Discard CSMA/CD altogether*

Repeater Hub

2 Pairs of fiber-optic cable

NIC with internal transceiver

a. 1000BASE-SX/LX
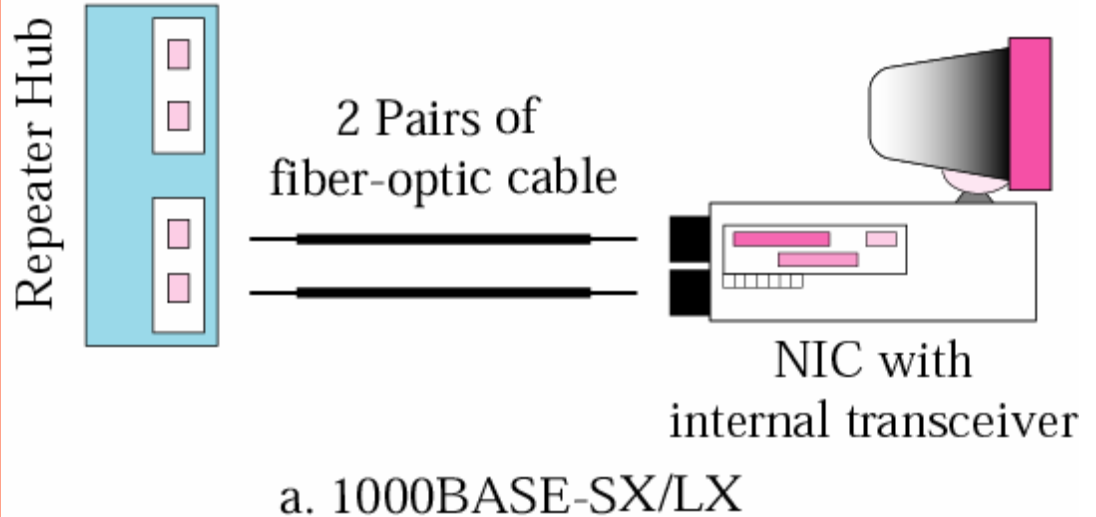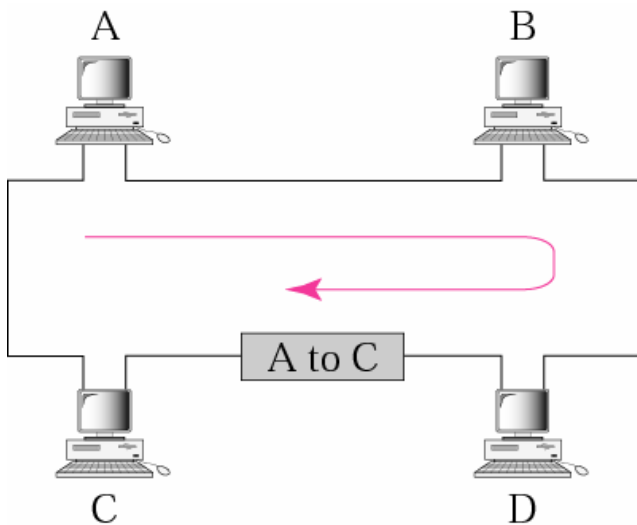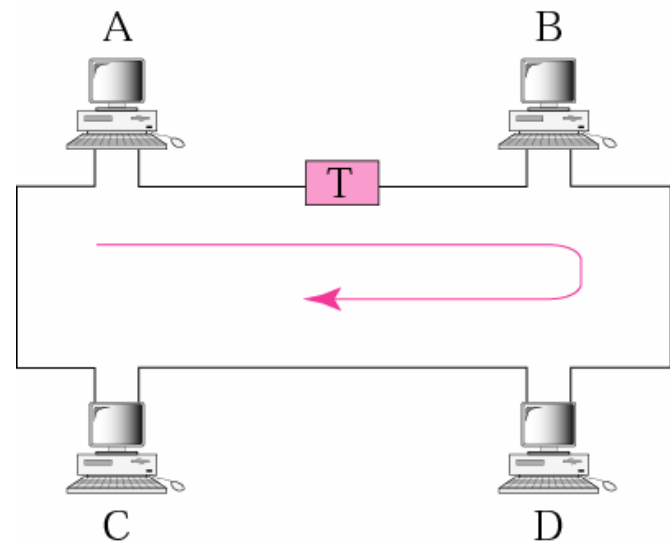
2) Token Ring

a. Station A captures the token
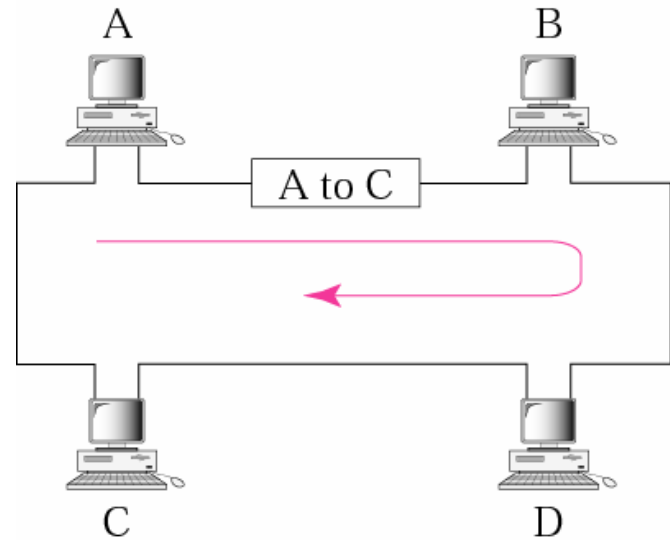
b. Station A sends data to station C

c. Station C copies data and sends frame back to A
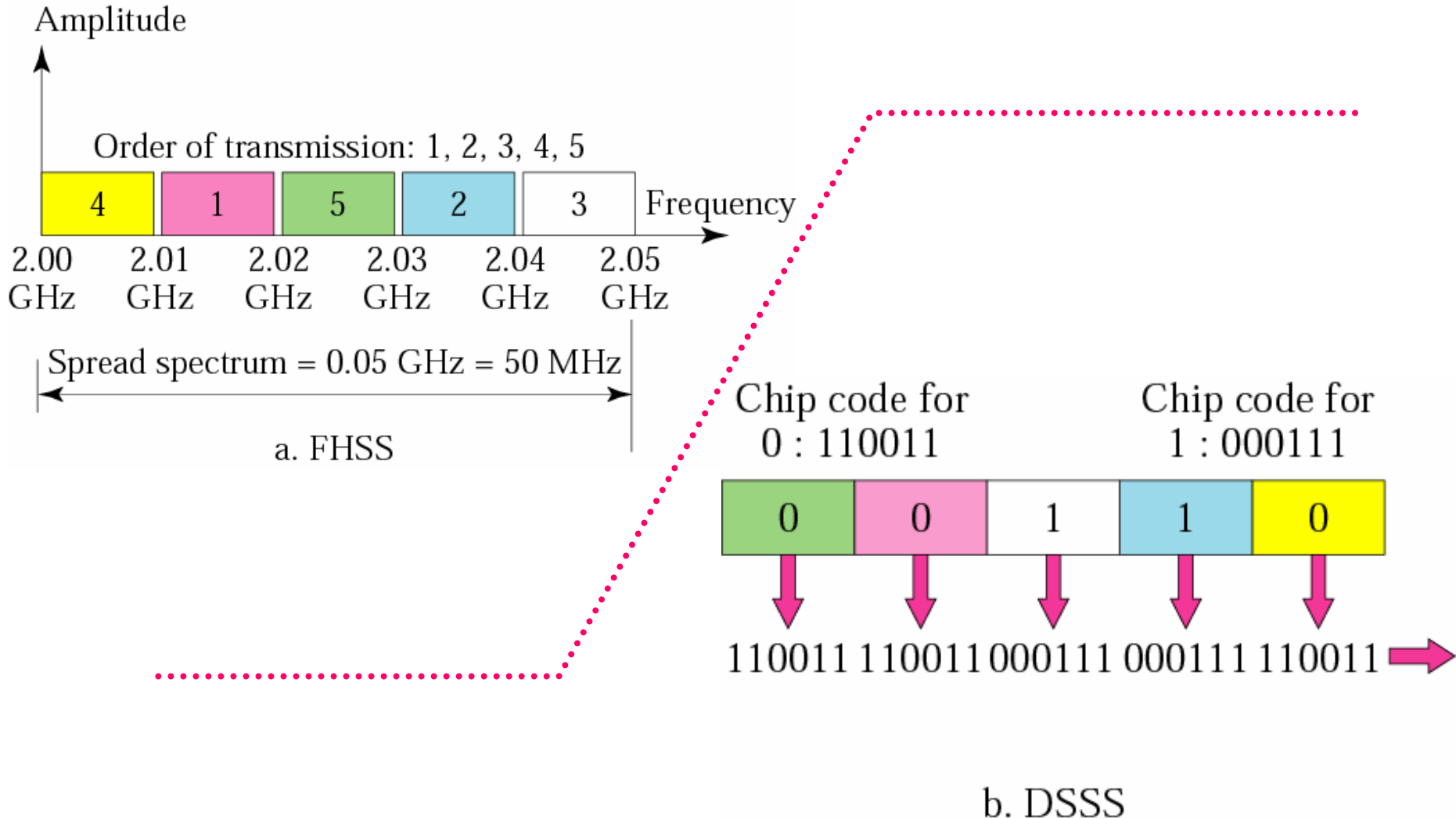
d. Station A releases the token

11

Token Ring
Data frame

SD Start delimiter (flag)   ED End delimiter (flag)
AC Access control (priority)   FS Frame status
FC Frame control (frame type)

SD	AC	FC	Destination address	Source address	Data	CRC	ED	FS
1 byte	1 byte	1 byte	6 bytes	6 bytes	Up to 4500 bytes	4 bytes	1 byte	1 byte

12

Token Ring Implementation
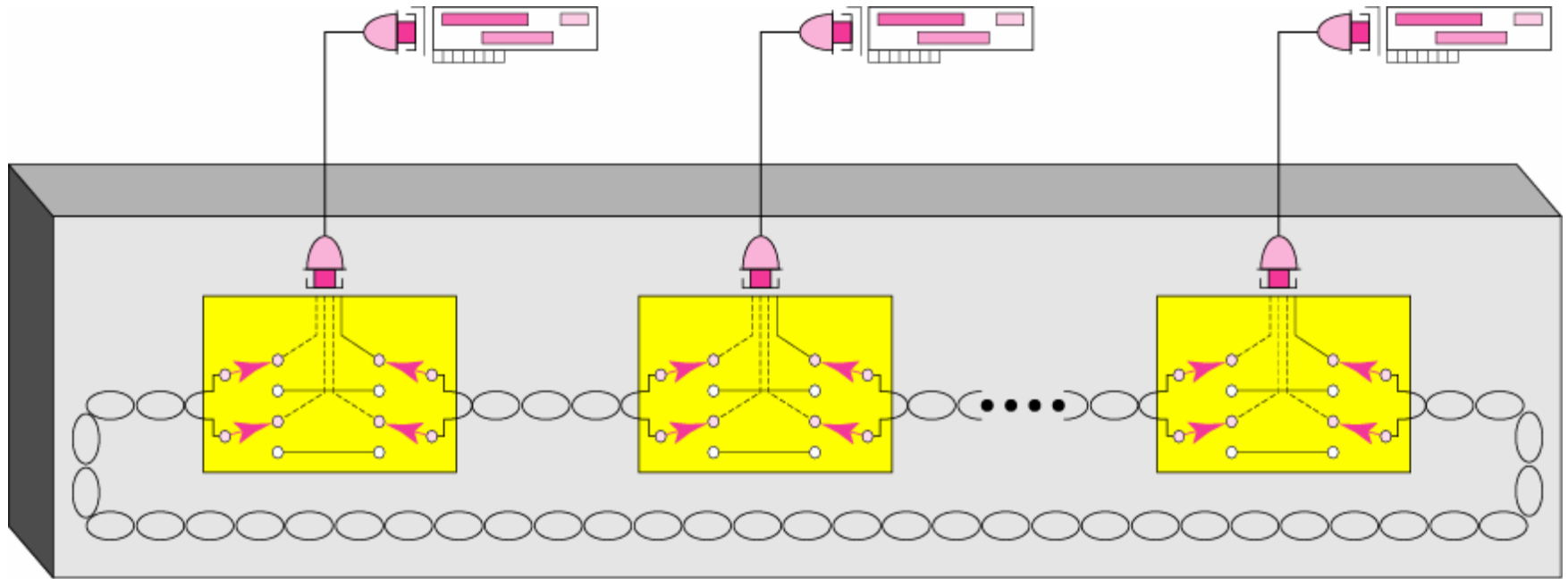
Multistation access unit
MAU

3) Wireless LAN
Spread spectrum techniques

Amplitude

Order of transmission: 1, 2, 3, 4, 5

| 4 | 1 | 5 | 2 | 3 |

Frequency

2.00 GHz 2.01 GHz 2.02 GHz 2.03 GHz 2.04 GHz 2.05 GHz

Spread spectrum = 0.05 GHz = 50 MHz

a. FHSS

Chip code for 0 : 110011   Chip code for 1 : 000111

| 0 | 0 | 1 | 1 | 0 |

110011 110011 000111 000111 110011

b. DSSS

14

Wireless LAN Architecture
1) Basic Service Set

BSS without AP

BSS with an AP
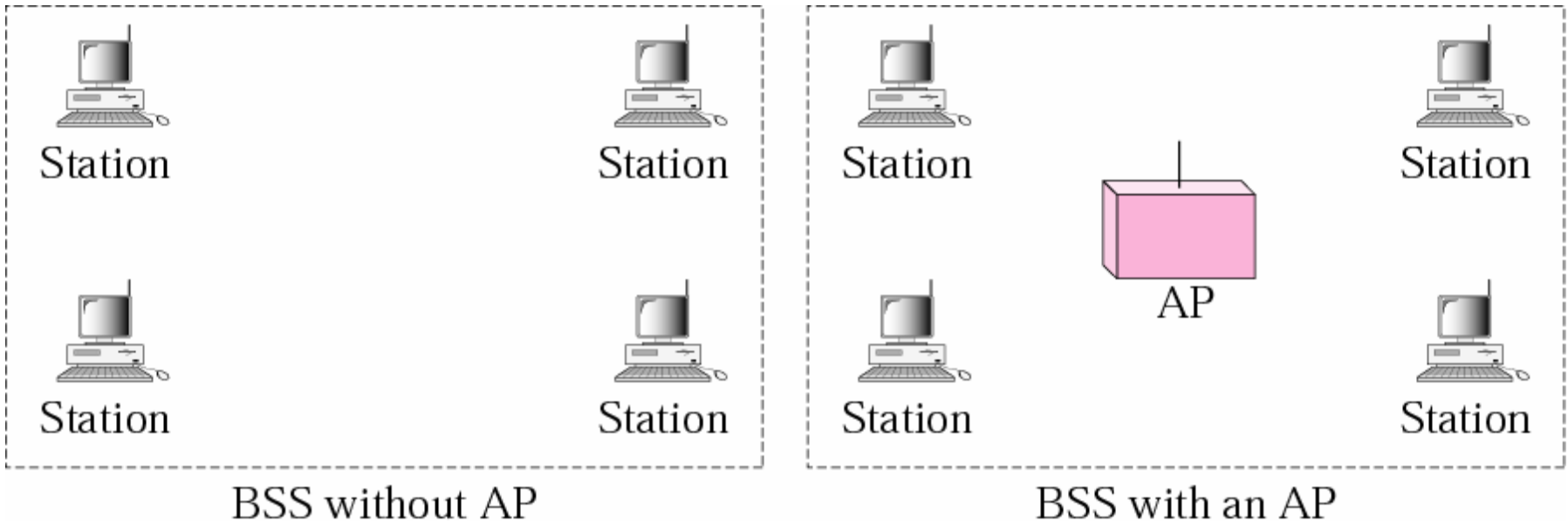
Wireless LAN Architecture
1) Extended Service Set
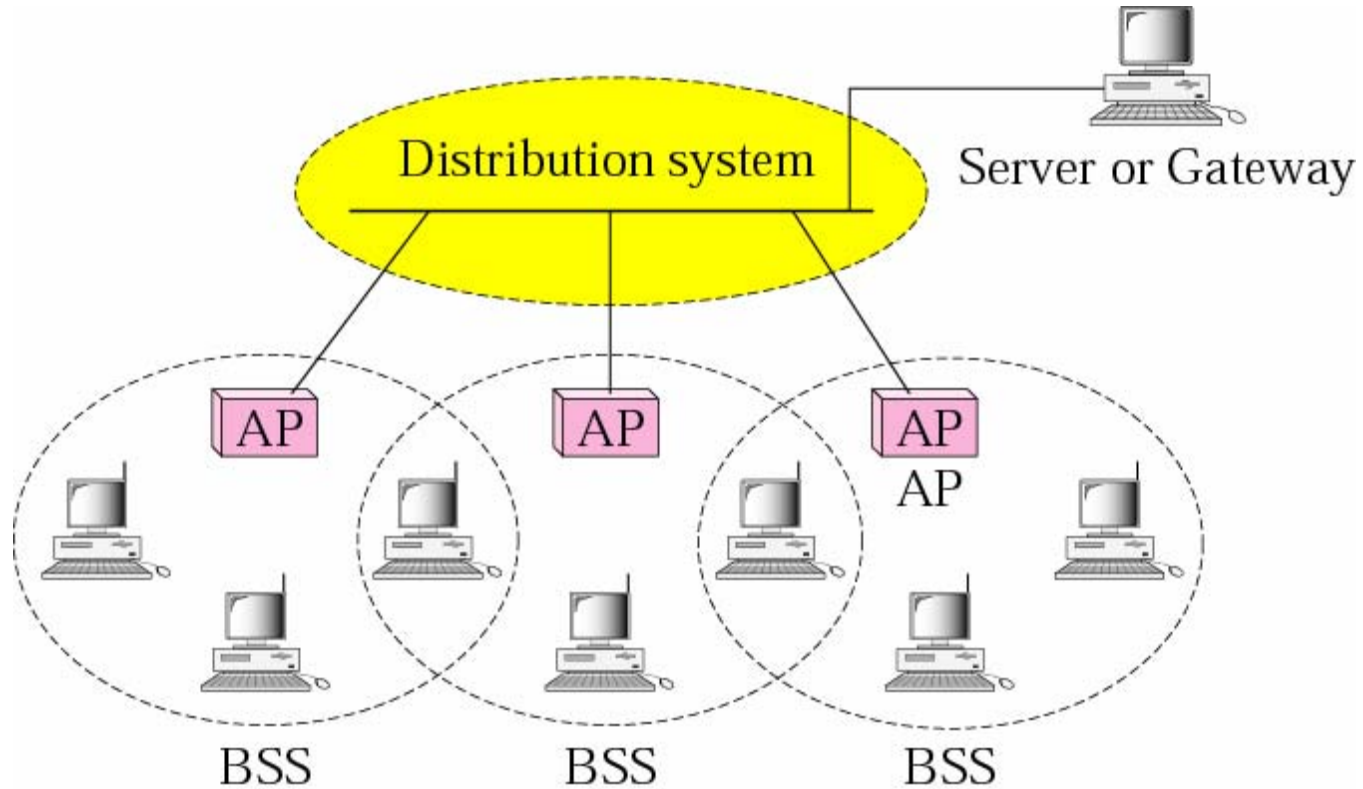
Collision Avoidance: CSMA/CA

A

B

RTS

CTS

Data

ACK

Time reserved for station A

Time

Time

17
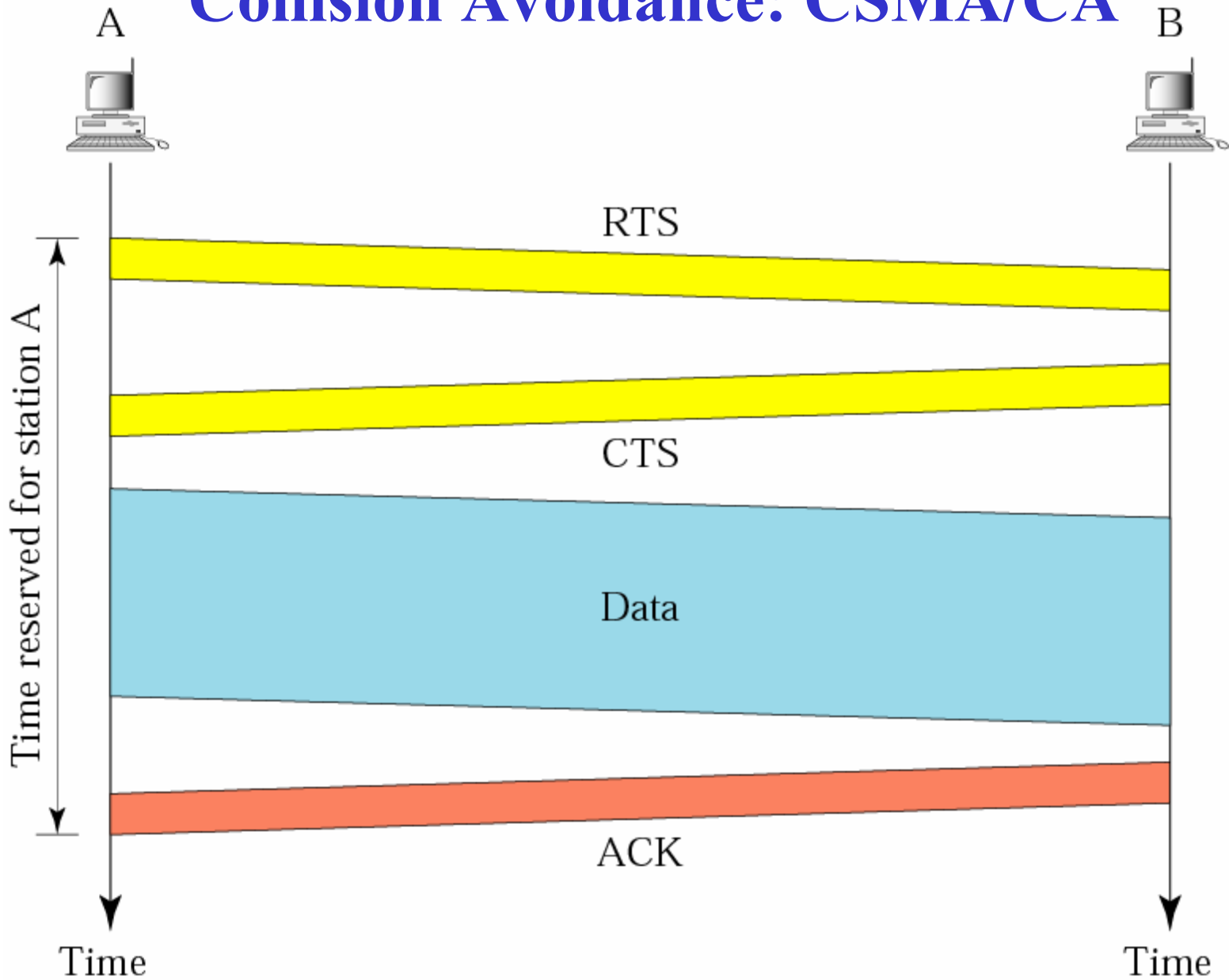
3.2

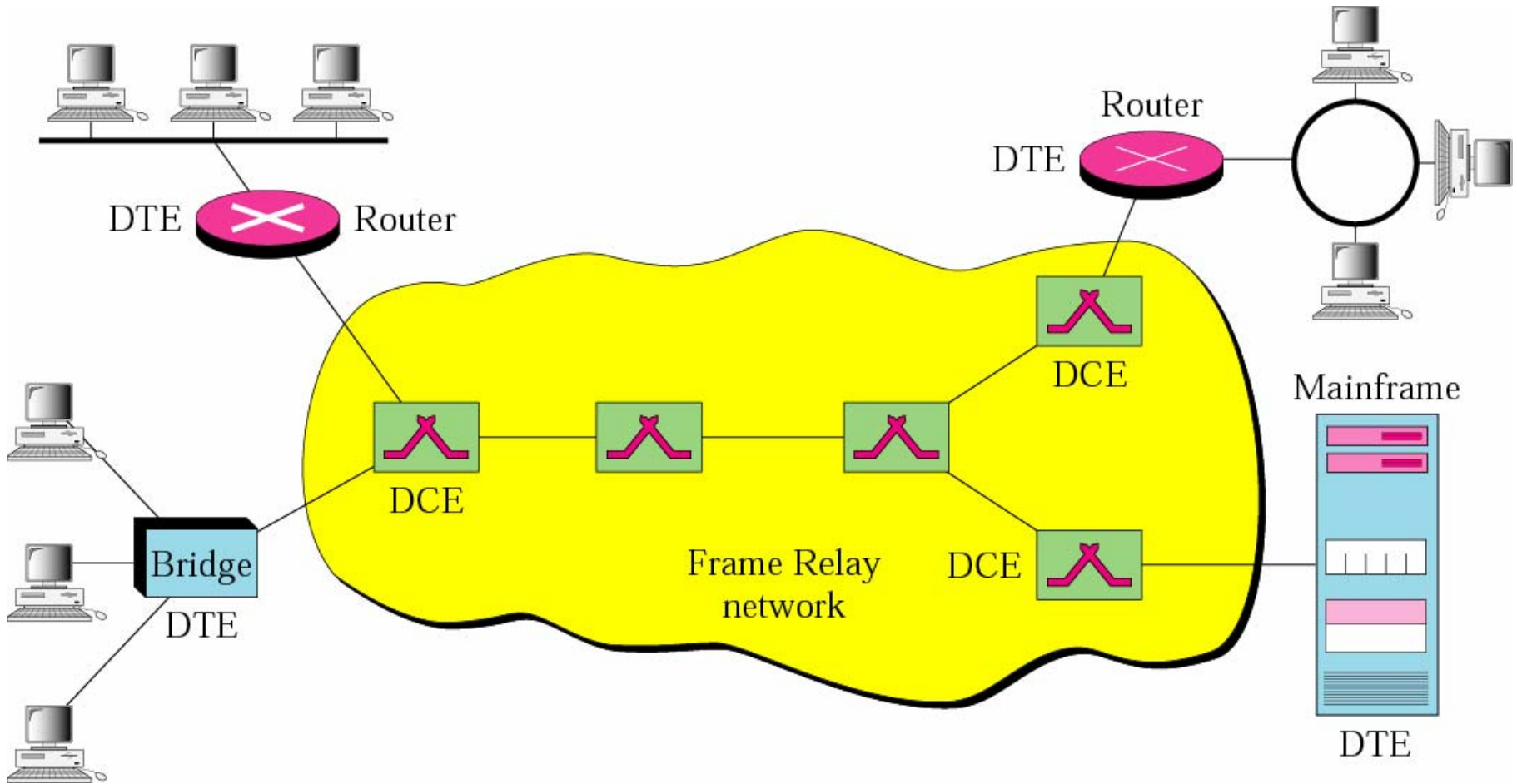# POINT-TO-POINT WANS
(Physical Layer Services)

Physical Layer Technologies

1. V.90 (56K) Modem

2. Digital Subscriber Line (DSL and its flavors)

3. Cable Modem

4. T-Lines:

   • T-1:   1.544 Mbps (eq. 24 voice channels)

   • T-3: 44.736 Mbps (eq. 28 T-1 = 672 voice channels)

5. SONET

   • OC-n: $n \in \{1,3,9,12,18,24,36,48,96,192\}$

   • 51.840 Mbps …. 9953.280 Mbps.

3.3

SWITCHED WANS
(A Connection-Oriented Technology)
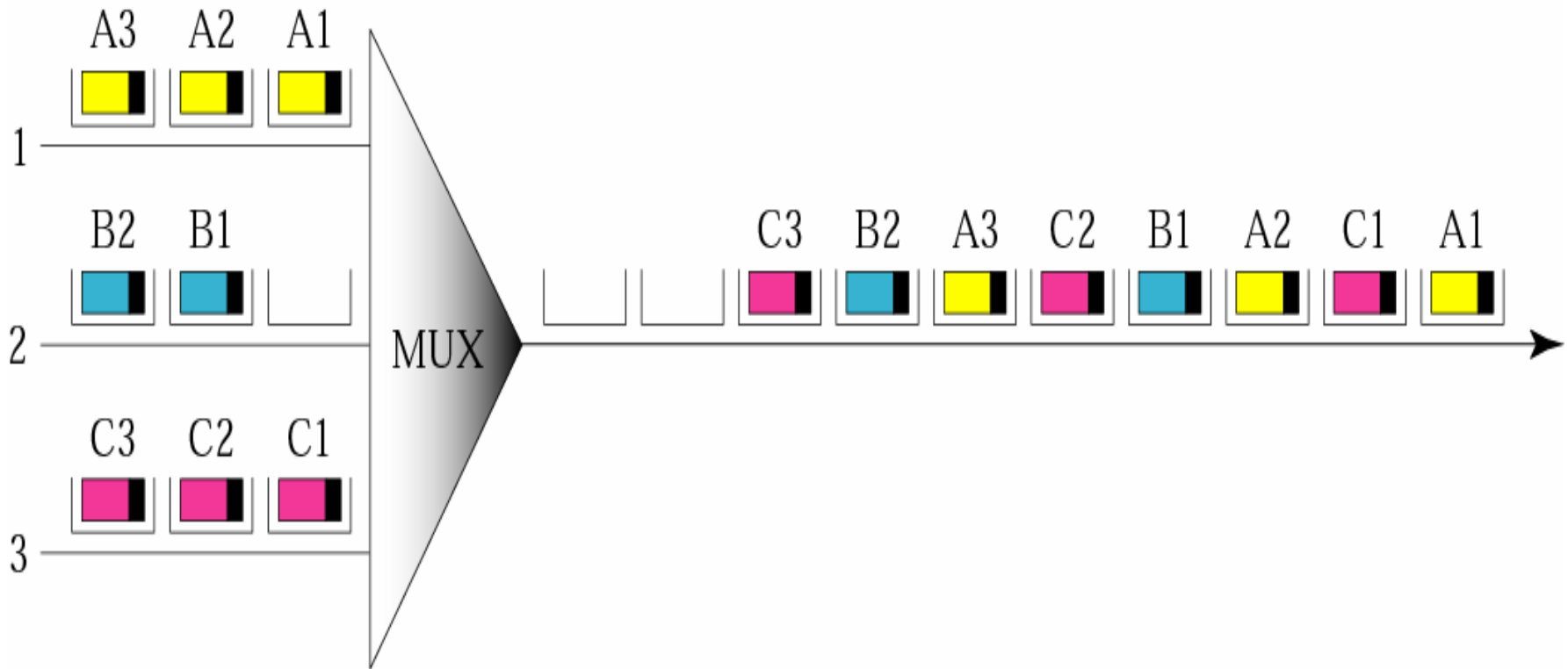
Frame Relay network

Asynchronous Transfer Mode
(Cell Relay) Networks

A cell network uses the cell as the basic unit of data exchange. A cell is defined as a small, fixed-sized (53-byte) block of information.
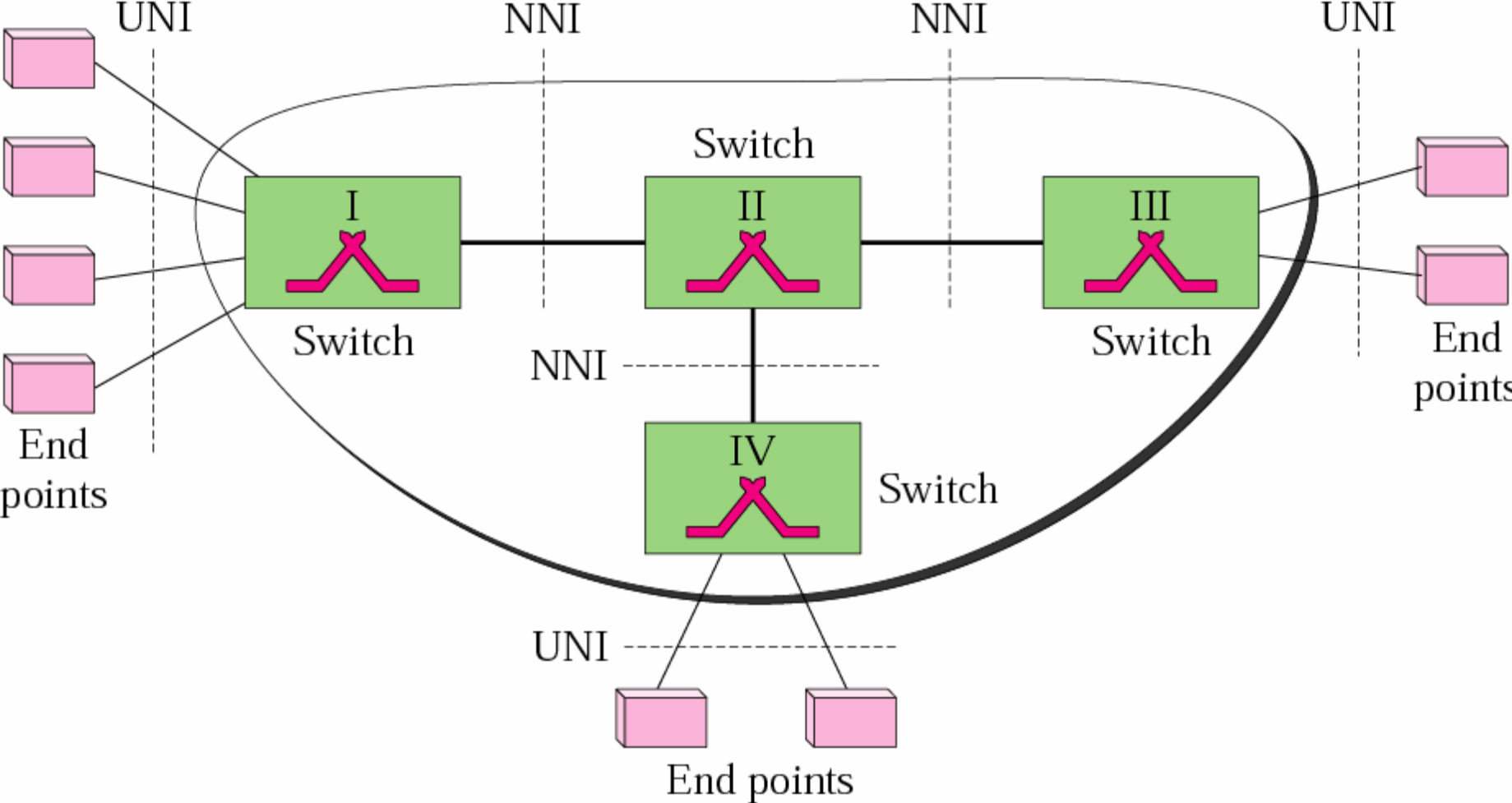
Objectives

1. Optimize use of high-data-rate transmission media

2. Interface with existing packet-switching (e.g. IP) networks

3. Connection-Oriented: reliable, predictable delivery
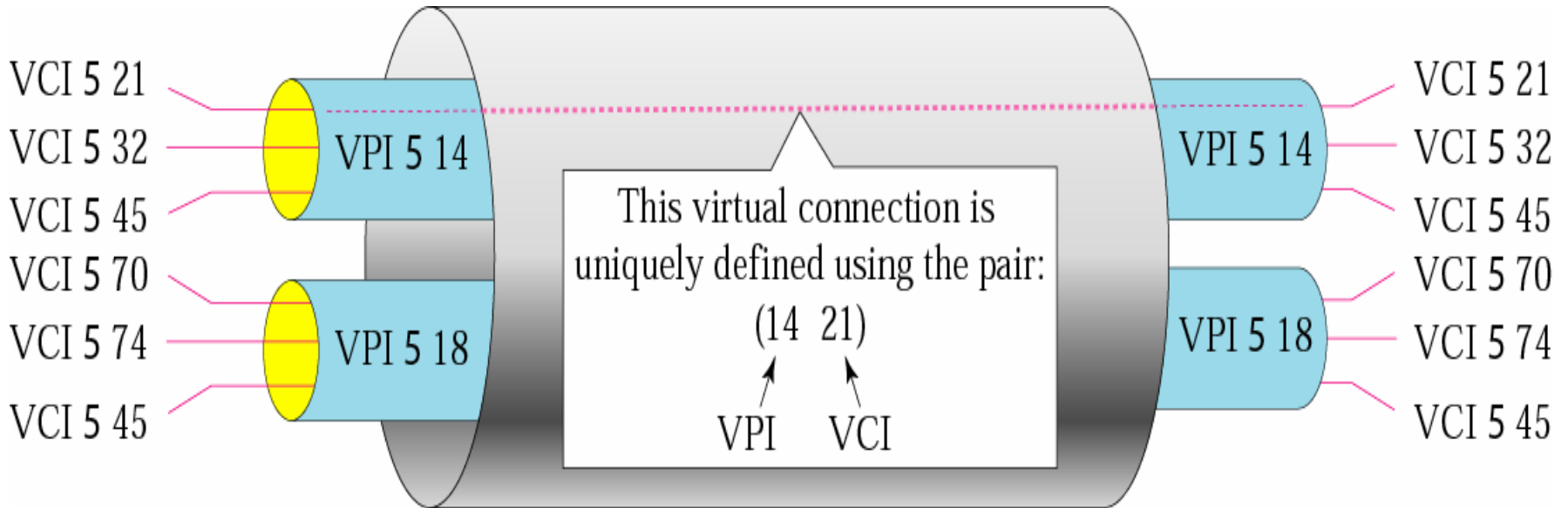
Asynchronous Time-Division Multiplexing
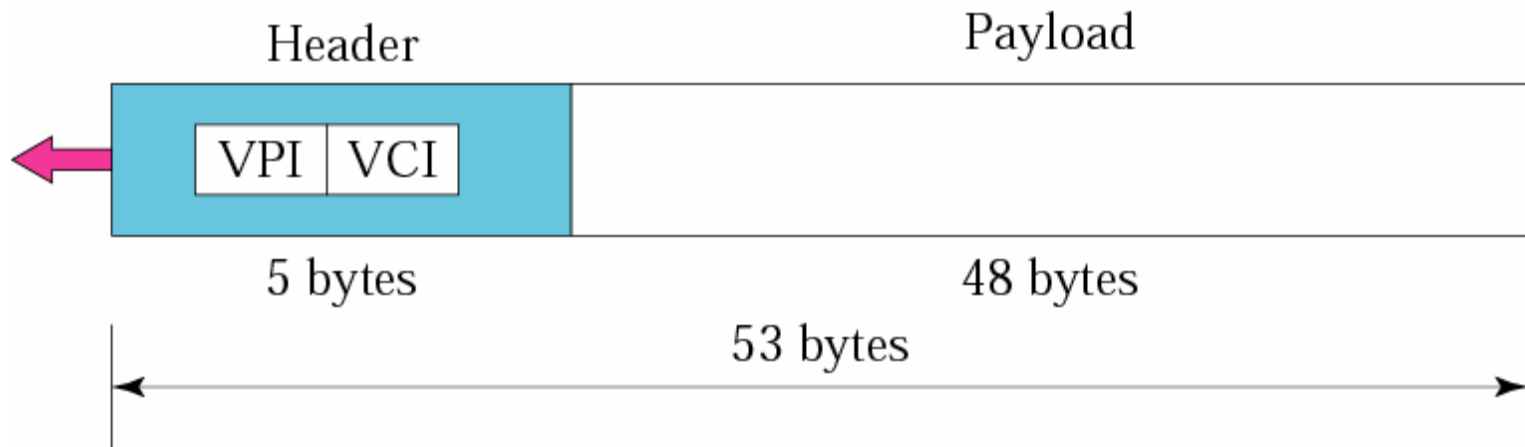
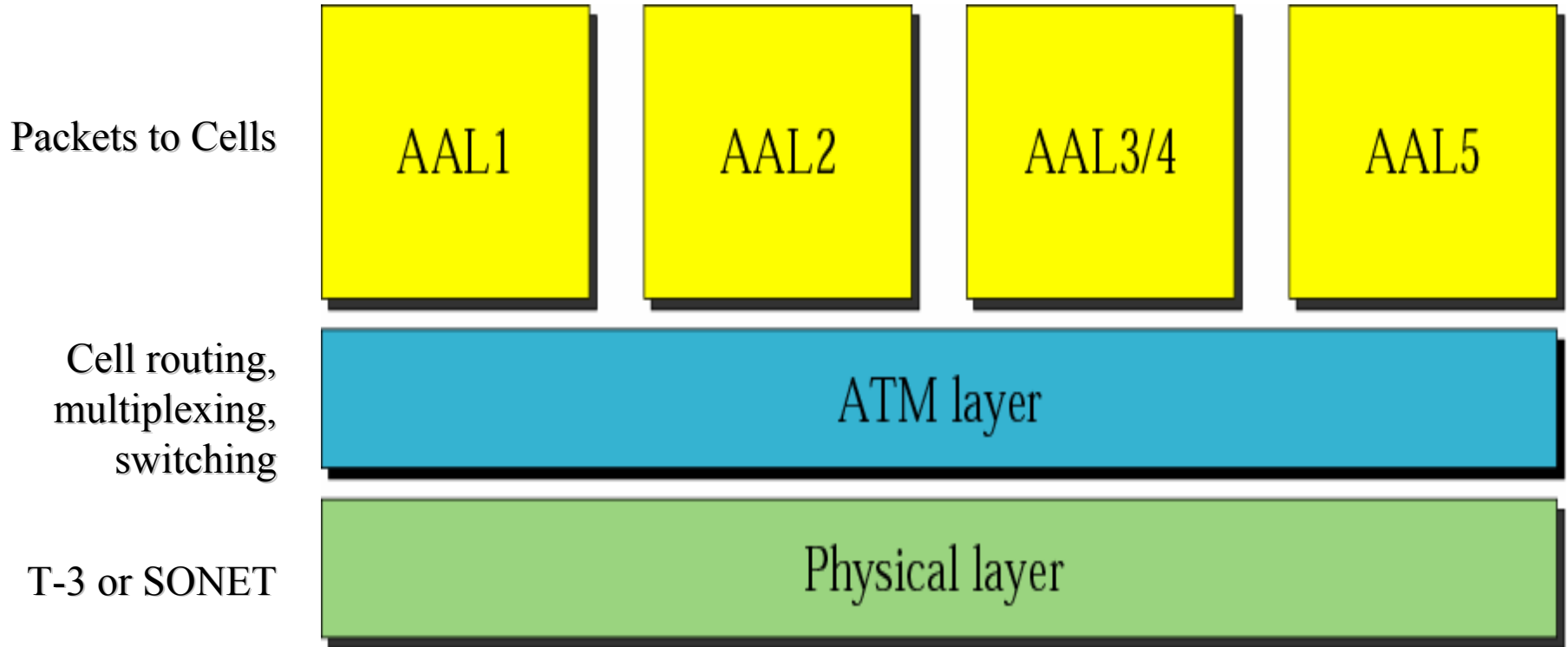# Architecture of an ATM network

Virtual Connections

VCI 5 21
VCI 5 32
VCI 5 45
VCI 5 70
VCI 5 74
VCI 5 45

VPI 5 14
VPI 5 18

This virtual connection is uniquely defined using the pair:

(14 21)

VPI   VCI

VPI 5 14
VPI 5 18

VCI 5 21
VCI 5 32
VCI 5 45
VCI 5 70
VCI 5 74
VCI 5 45

Note that a virtual connection is defined by a pair of numbers: the VPI and the VCI.

An ATM cell

ATM layers

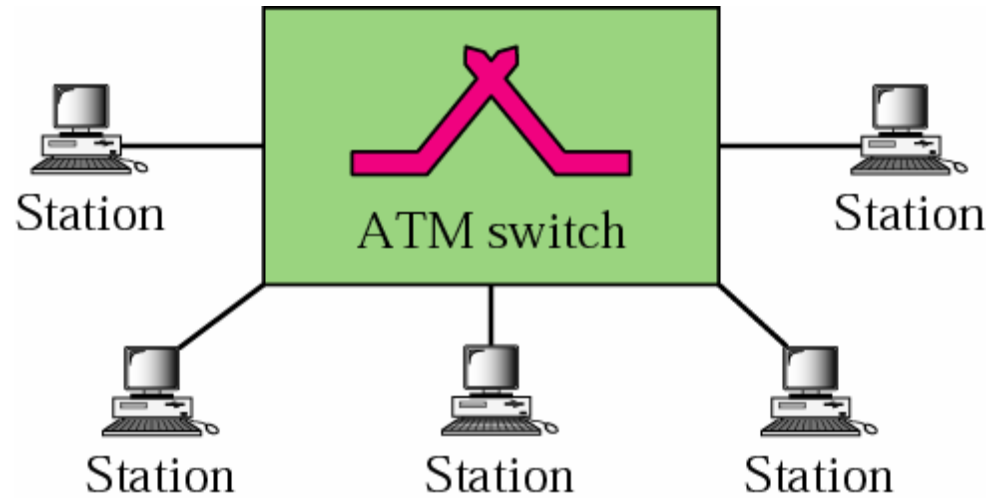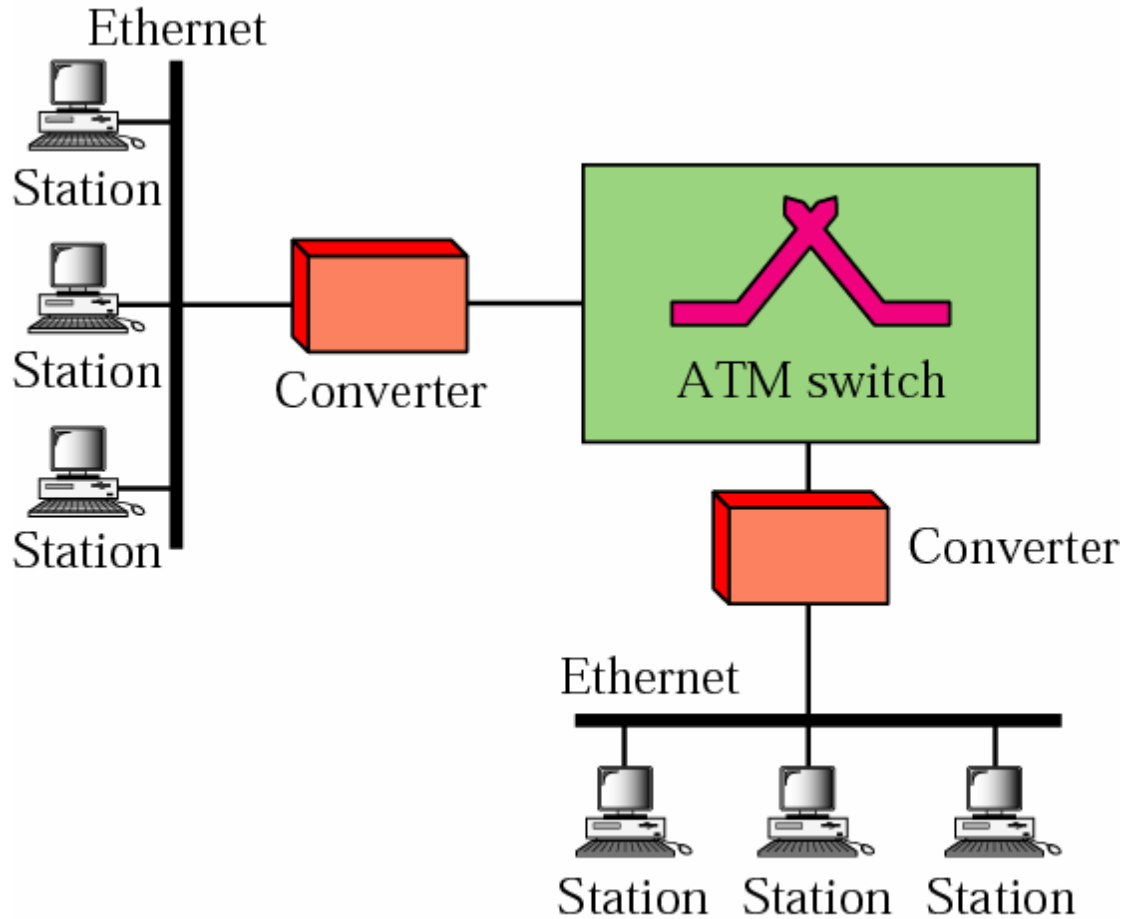|				
Packets to Cells	AAL1	AAL2	AAL3/4	AAL5
Cell routing, multiplexing, switching	ATM layer			
T-3 or SONET	Physical layer			

The IP protocol uses the AAL5 sublayer.
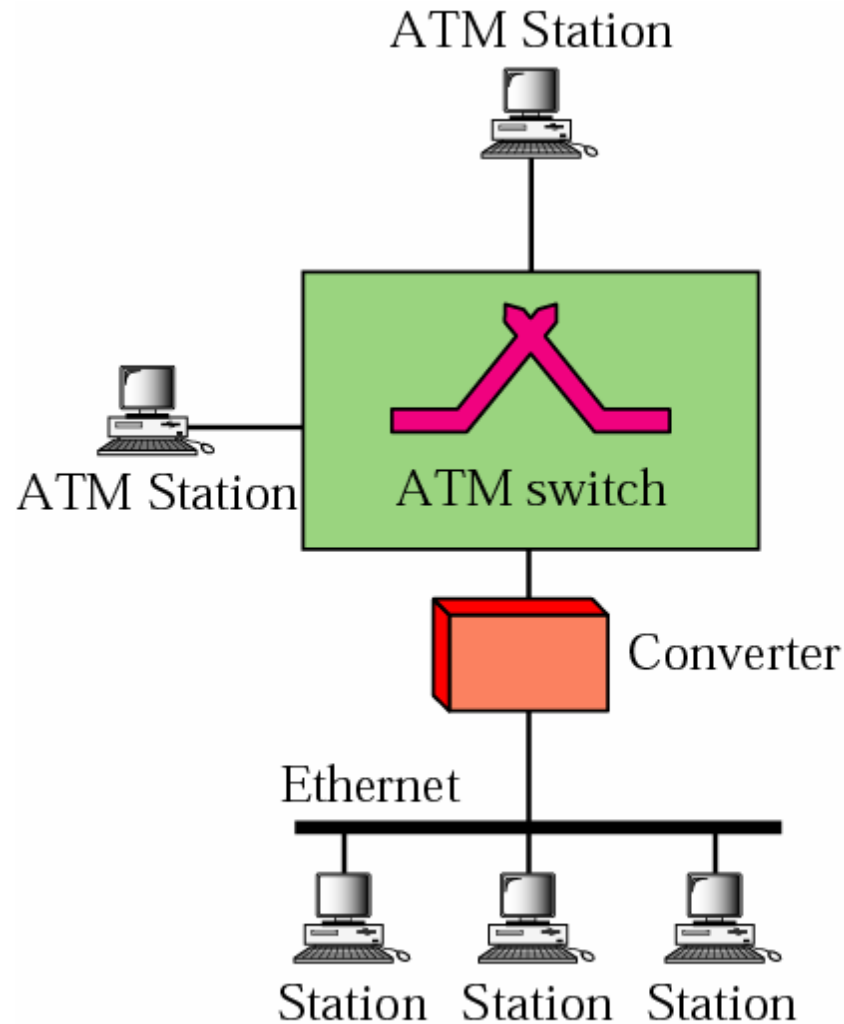
ATM LAN architecture

a. Pure ATM LAN

ATM LAN architecture

b. Legacy ATM LAN
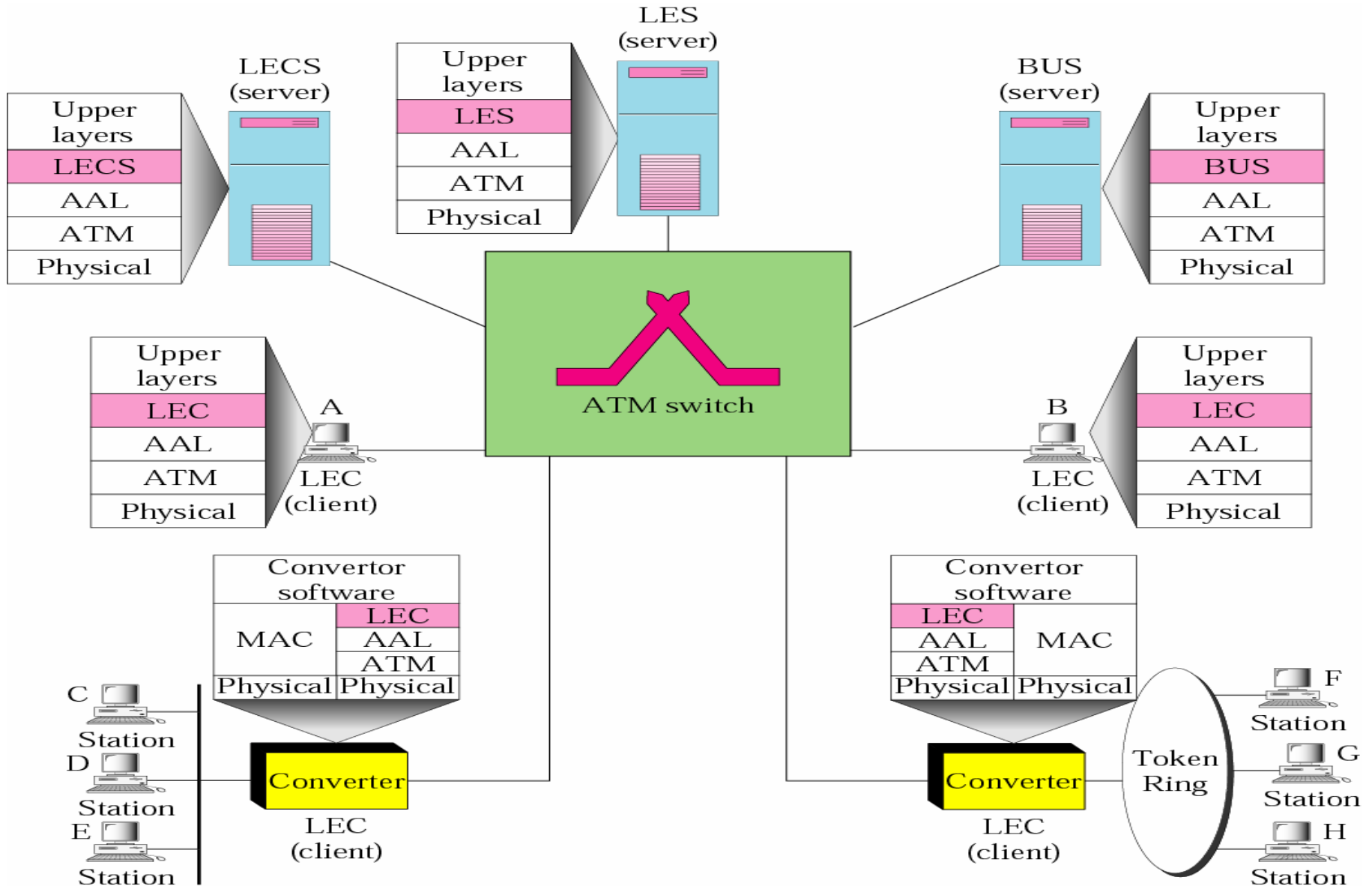
ATM LAN architecture

c. Mixed architecture ATM LAN

LAN Emulation (LANE)

- Connectionless vs. Connection-oriented
- Physical addresses vs. Virtual Connection IDs
- Multicasting and Broadcasting Delivery
- Interoperability
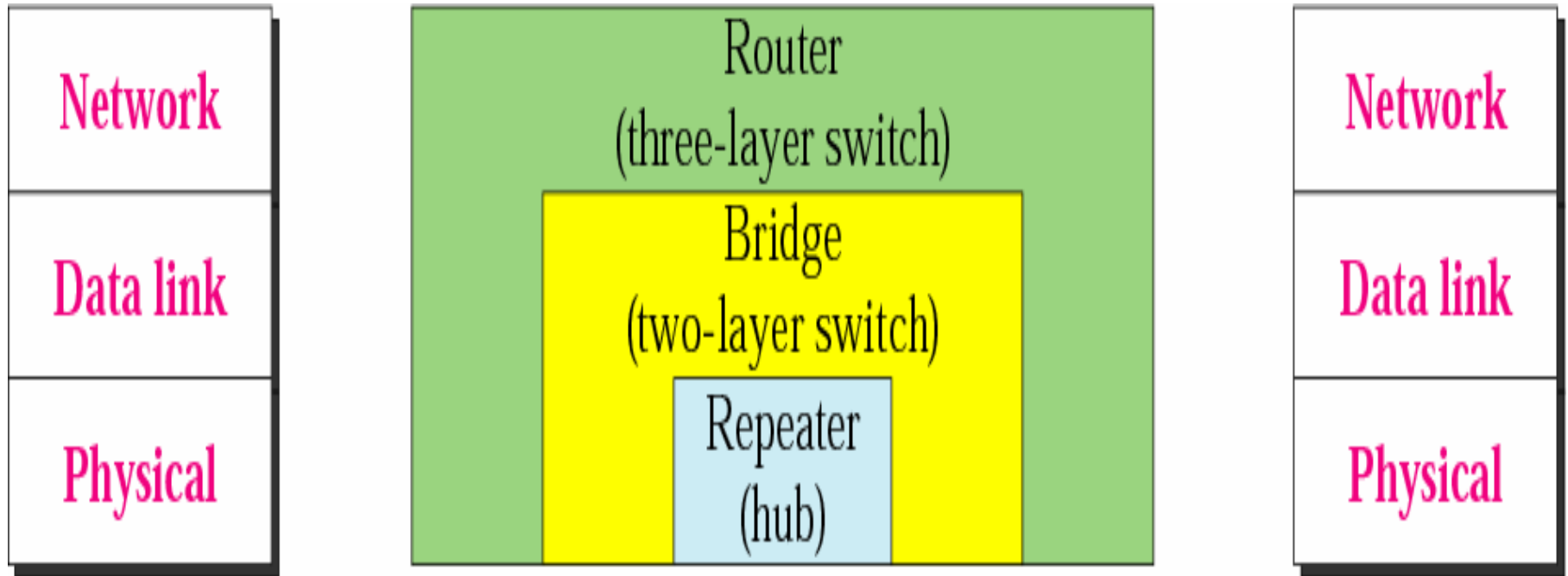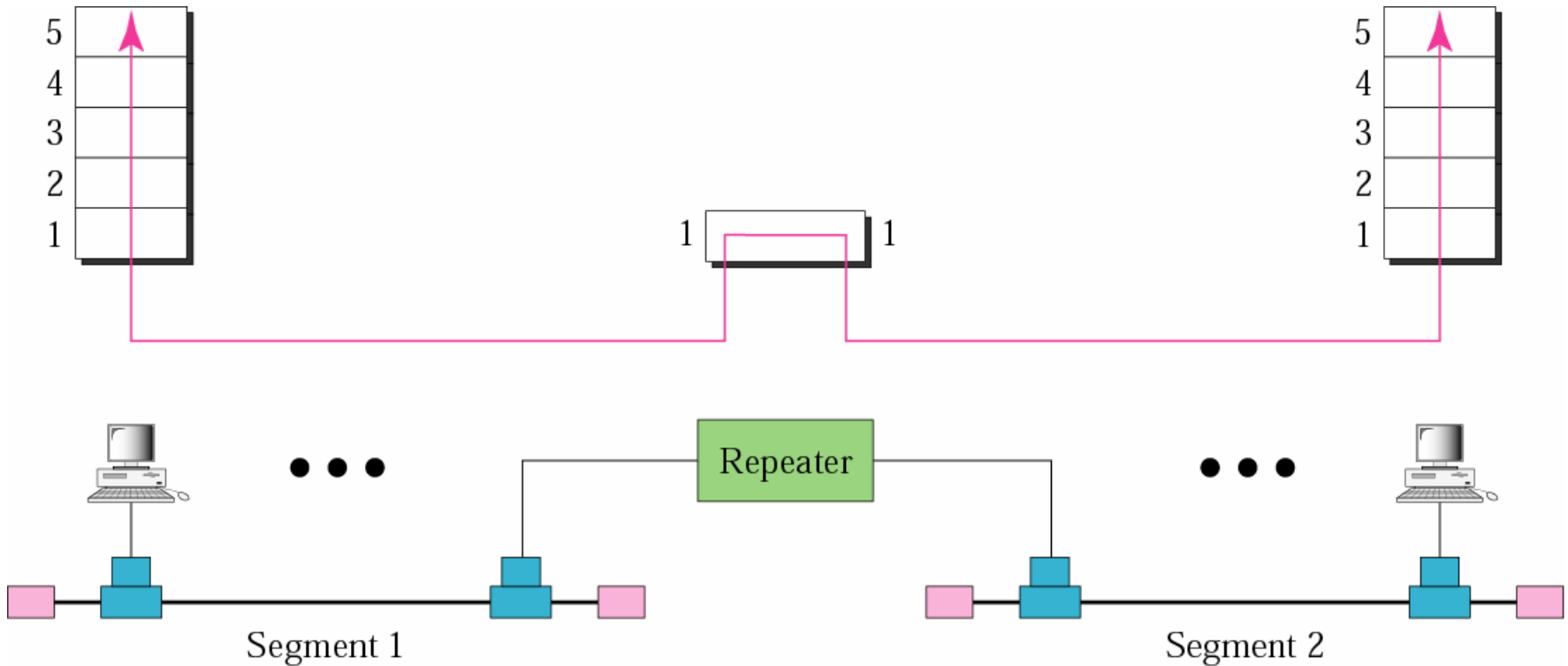
A mixed architecture ATM LAN using LANE

3.4

CONNECTING DEVICES
Joining LANs and WANs

5 Types of Connecting devices

Repeater

5			5
4			4
3			3
2			2
1			1

Segment 1   Segment 2

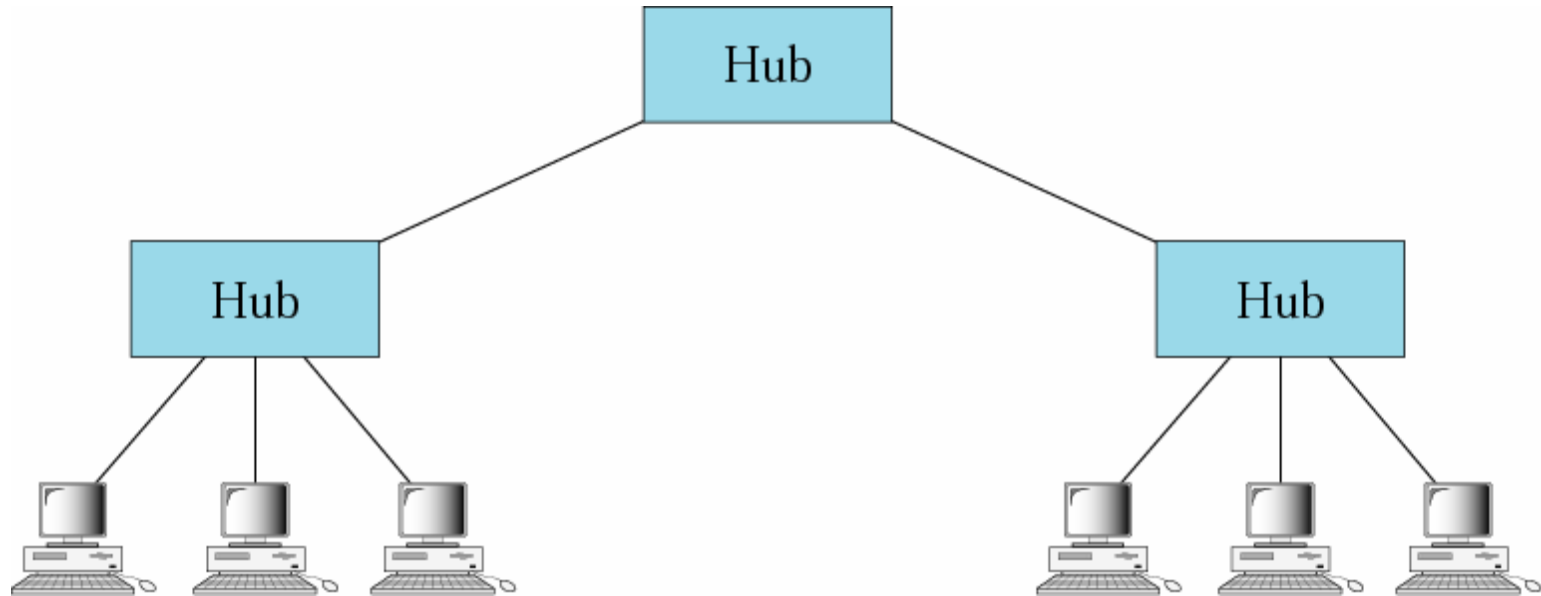## A repeater

- *connects segments of a LAN together.*

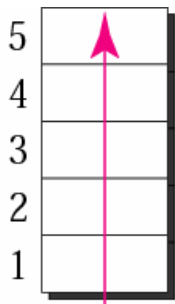- *Forwards every packet; it has no filtering capability.*
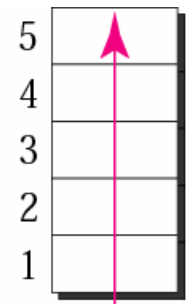
Hubs
Multi-Port Repeaters

Still ONE LAN.

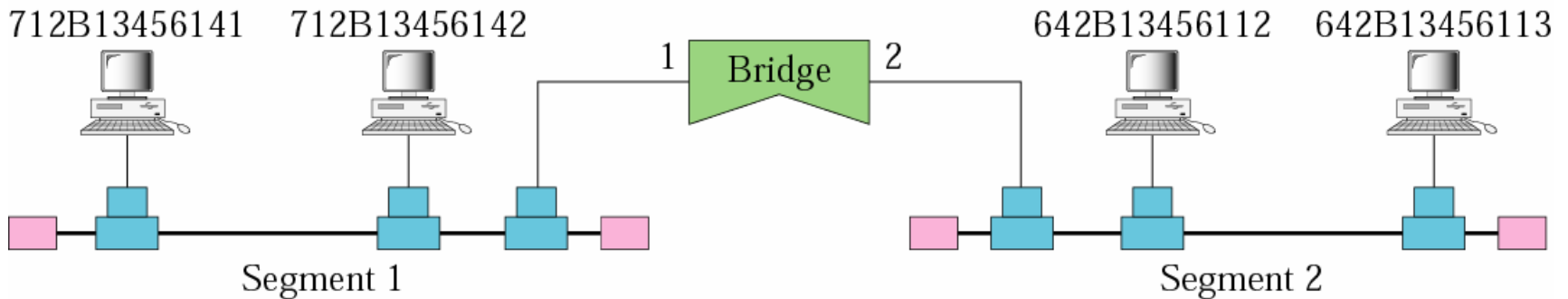- **Forwards every packet; it has no filtering capability.**

Bridge

Address	Interface
712B13456141	1
712B13456142	1
642B13456112	2
642B13456113	2

Bridge table

712B13456141   712B13456142

Segment 1

1   Bridge   2

642B13456112   642B13456113

Segment 2

A bridge has a table used in filtering decisions, may have several interfaces.

Routing example

A router is a three-layer (physical, data link, and network) device.