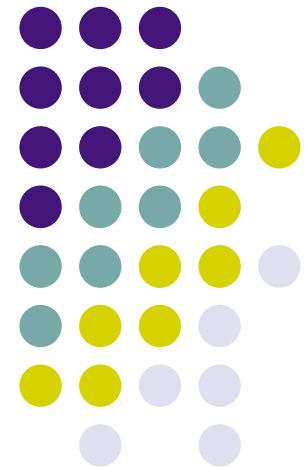
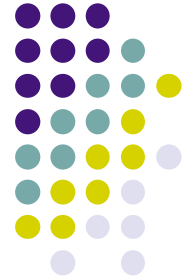


# Physical layer





# Overview

- Physical layer is responsible for transmission of a stream of bits
  - Put bits from a machine to a medium
  - Pick bits from the medium give to another machine
- Some issues
  - Medium
  - Line Encoding: representing the digital logic levels using the physical attributes associated with the media.
  - Multiplexing

# From signal to packet



Analog Signal



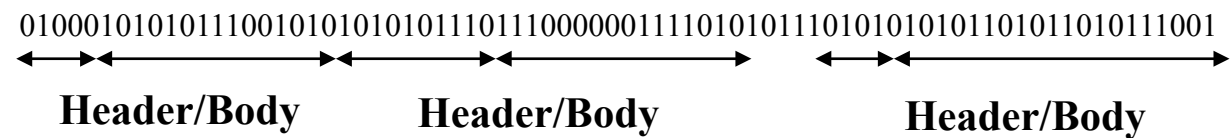
“Digital” Signal



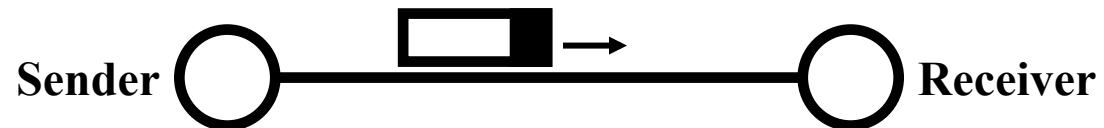
Bit Stream

**0 0 1 0 1 1 1 0 0 0 1**

Packets



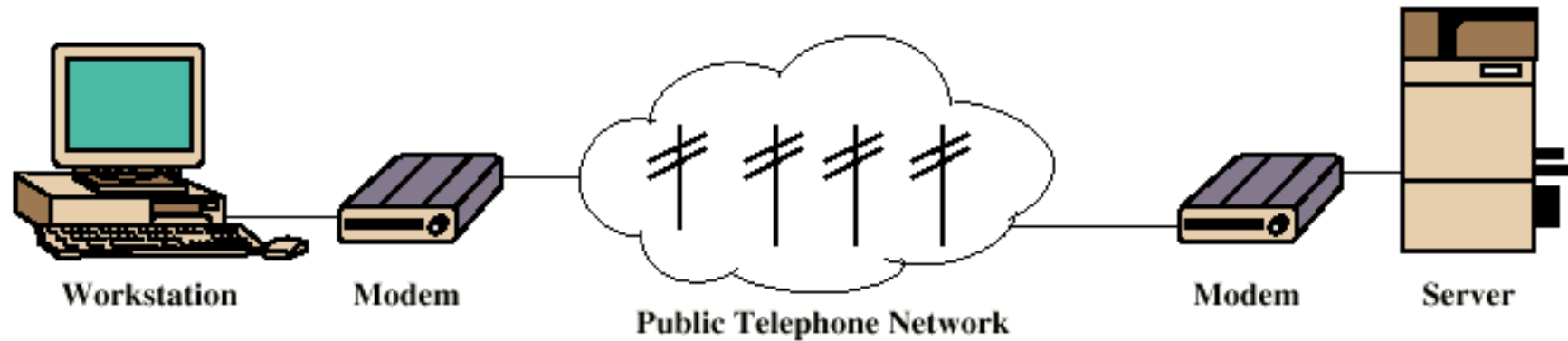
Packet  
Transmission



# Model of data transmission system



(a) General block diagram



(b) Example

# Data Communication networks

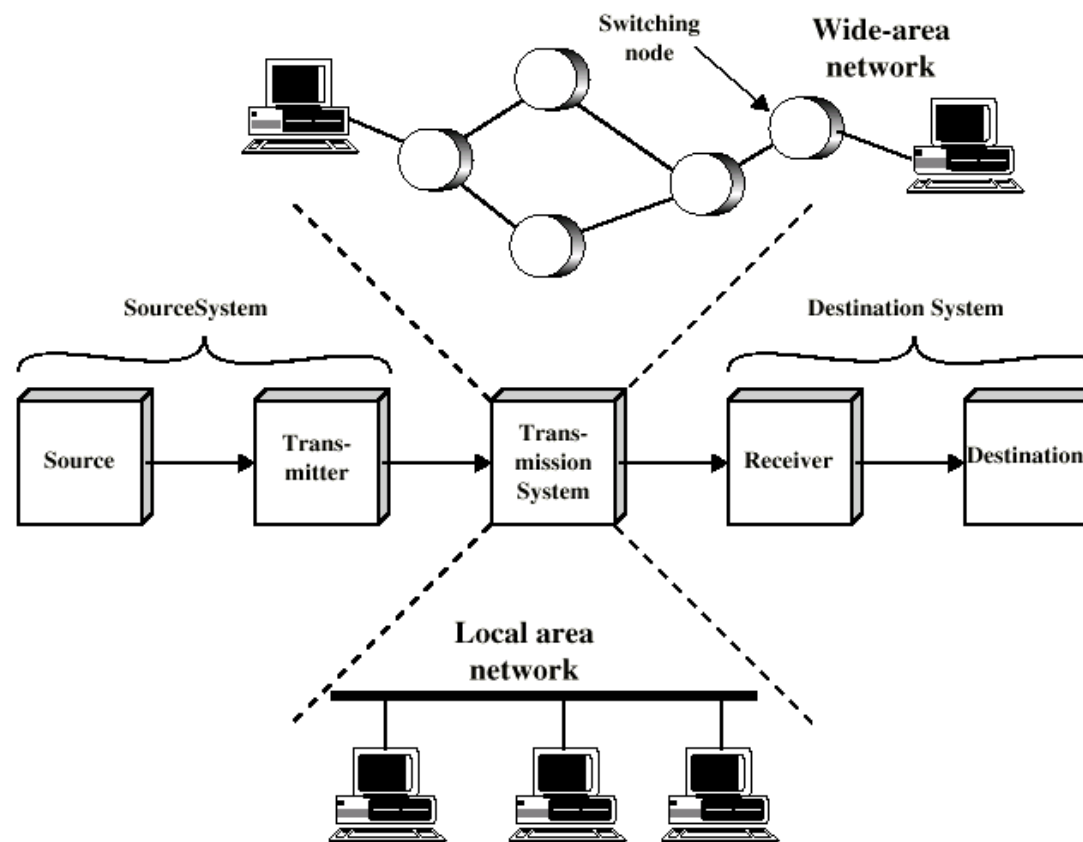
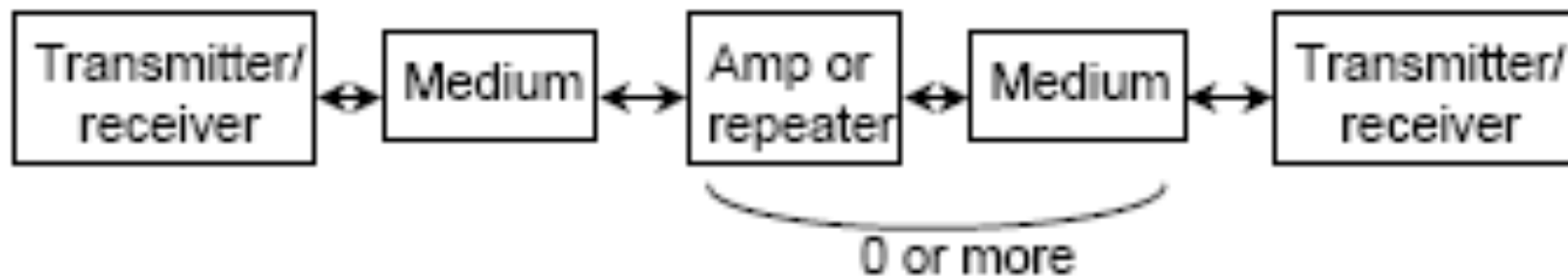
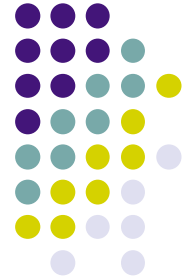


Figure 1.3 Simplified Network Models

# Direct Data transmission system





# Media

- Wired
  - Twisted Pair
  - Coaxial Cable
  - Fiber Optics
- Wireless
  - Radio
  - Infra red
  - Light
  - ...

# Twisted pair



(a)



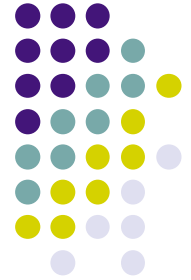
(b)

(a) Category 3 UTP.

(b) Category 5 UTP.



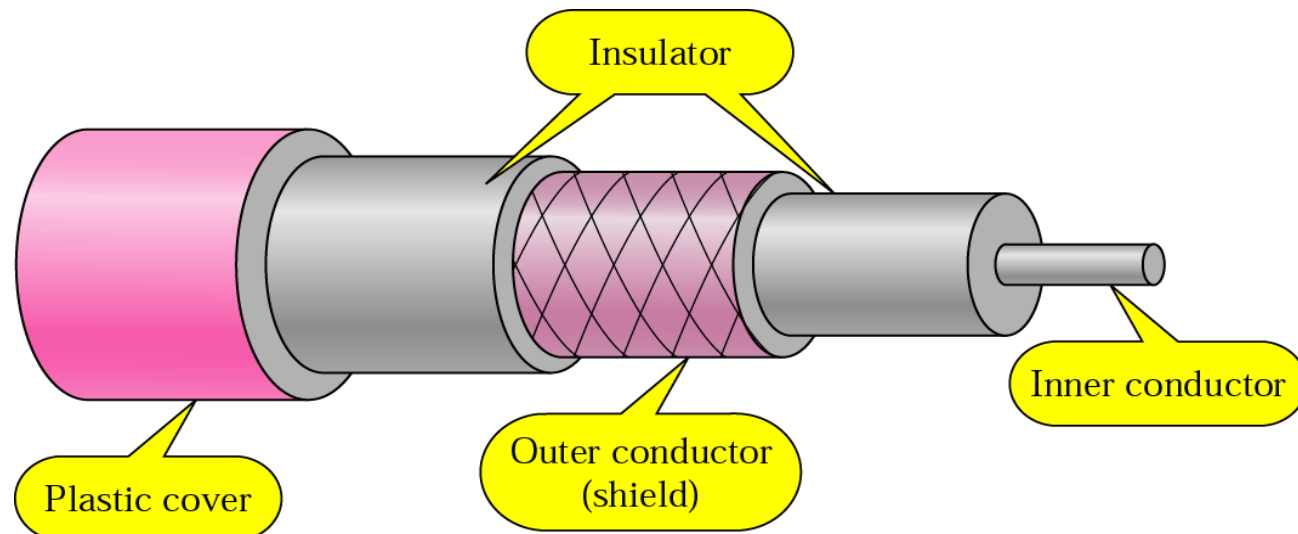
# Evaluation



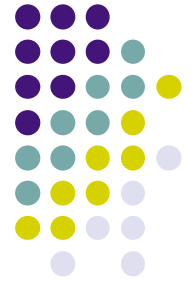
- Cheap, simple
- Widely used
- Weak resistance to noise
- Short Transmission distance
- Need amplification after each 5km in analog transmission
- In digital transmission
  - Need repeater after each 2 km
- Limited speed (100MHz)
- Noise



## II. Coaxial



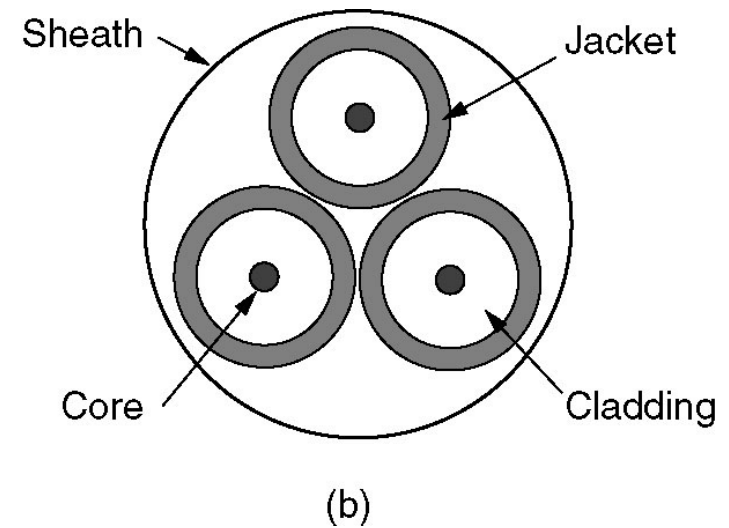
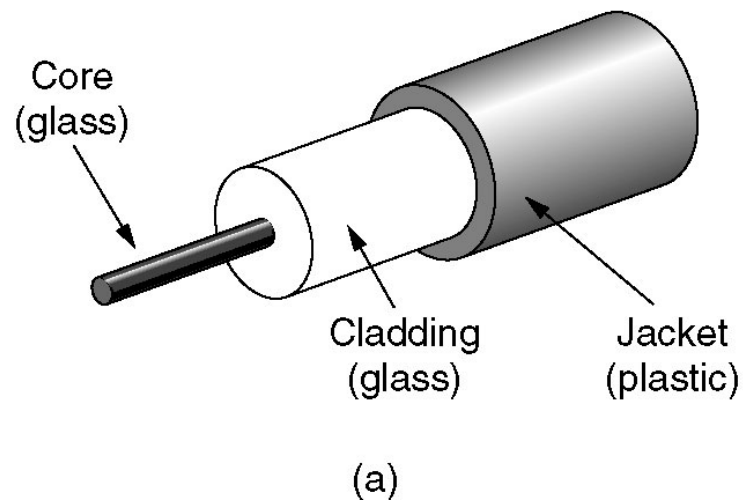
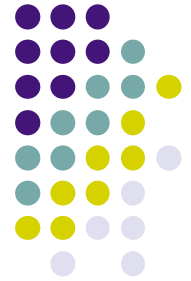
Category	Impedance	Use
RG-59	75 $\Omega$	Cable TV
RG-58	50 $\Omega$	Thin Ethernet
RG-11	50 $\Omega$	Thick Ethernet



# Application

- Using in TV transmission
- For transmission of telephone signal
  - 10,000 calls in the same time
  - Is being replaced by fiber optics
- Linking the computers of the short distance
- LAN 10BaseT, 100BaseT, ...
- For digital transmission
  - Repeater should be used after each 1km
  - More repeater is needed for high speed transmission

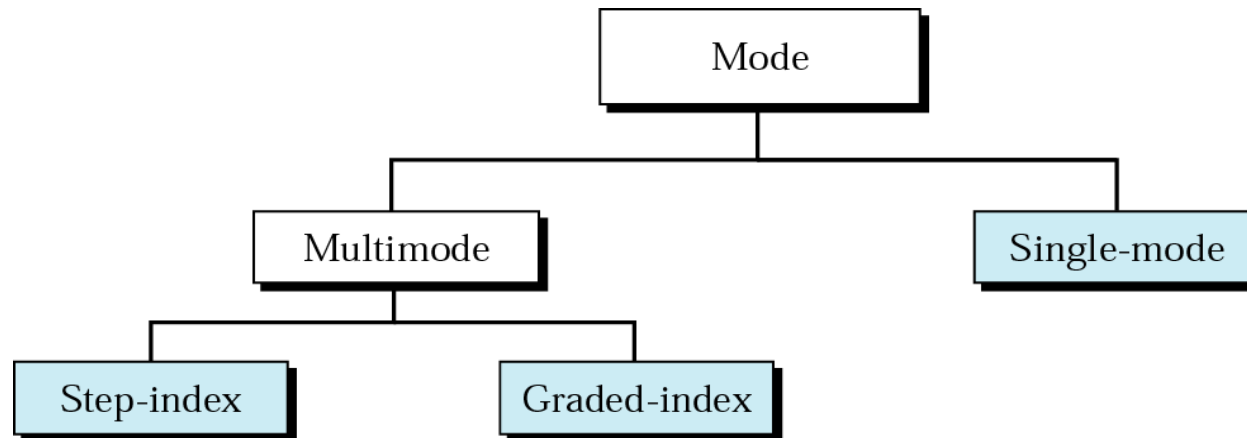
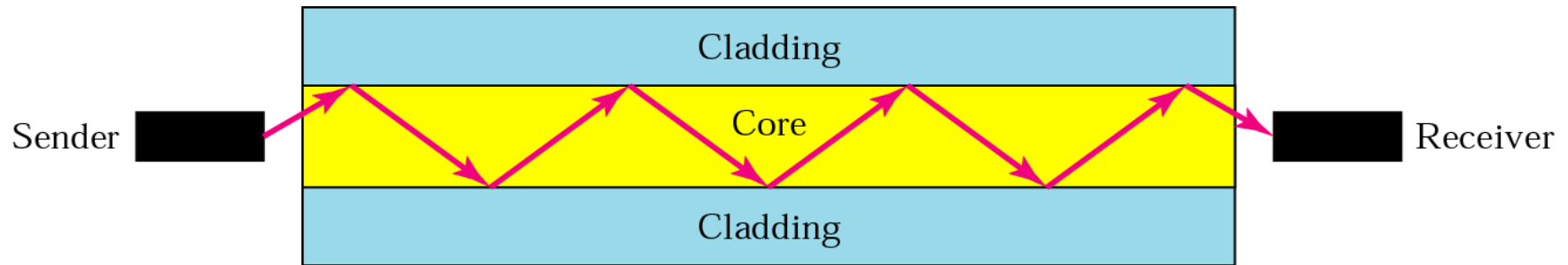
# Optical fiber



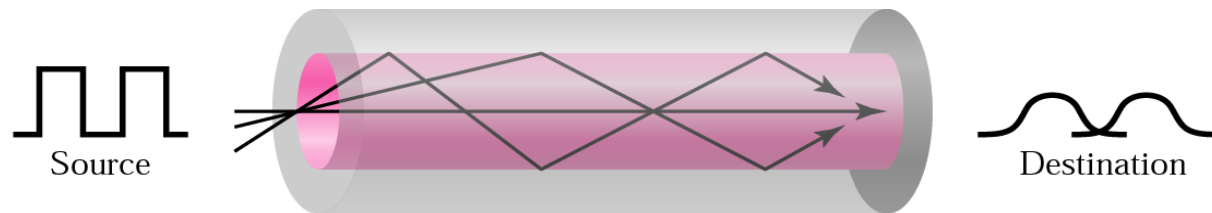
(a) Single core

(b) Cable with 3 cores

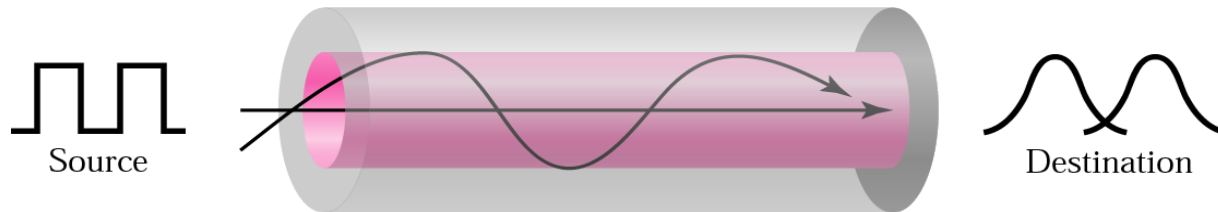
# Optical fiber transmission mode



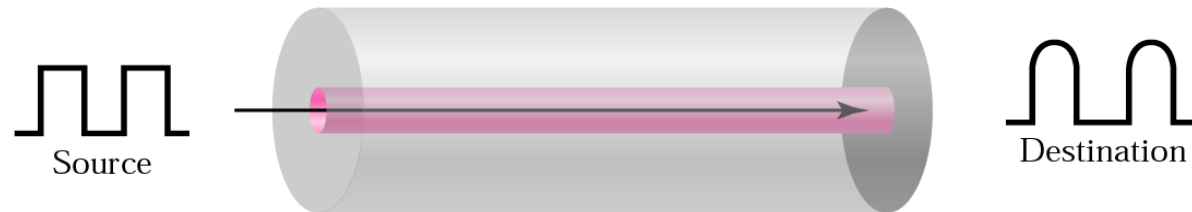
# Optical fiber



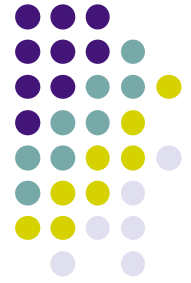
a. Multimode, step-index



b. Multimode, graded-index

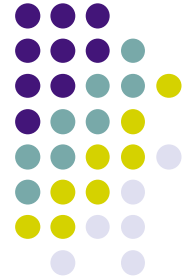


c. Single-mode



# Application of optical fiber

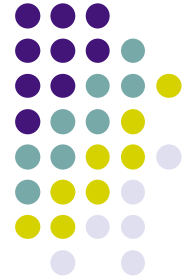
- Used for long distance transmission
- Used for communication in metropolitan networks
- Used for connecting routers of ISP
- Used in backbone part of a LAN
- Advantage in comparison with other cables
  - Large data rate
  - Small and light cable
  - Low attenuation
  - Better isolation from electromagnetic environment
  - Large distance between repeaters (10km)



# Wireless media

- Terrestrial microwave
  - Used for metropolitan connection, for cellular network
- Microwave satellite
  - Used in TV, Long distance telephone communication
- Radio broadcast
- Infrared
  - Small scope, low data rate, unable to travel through the wall

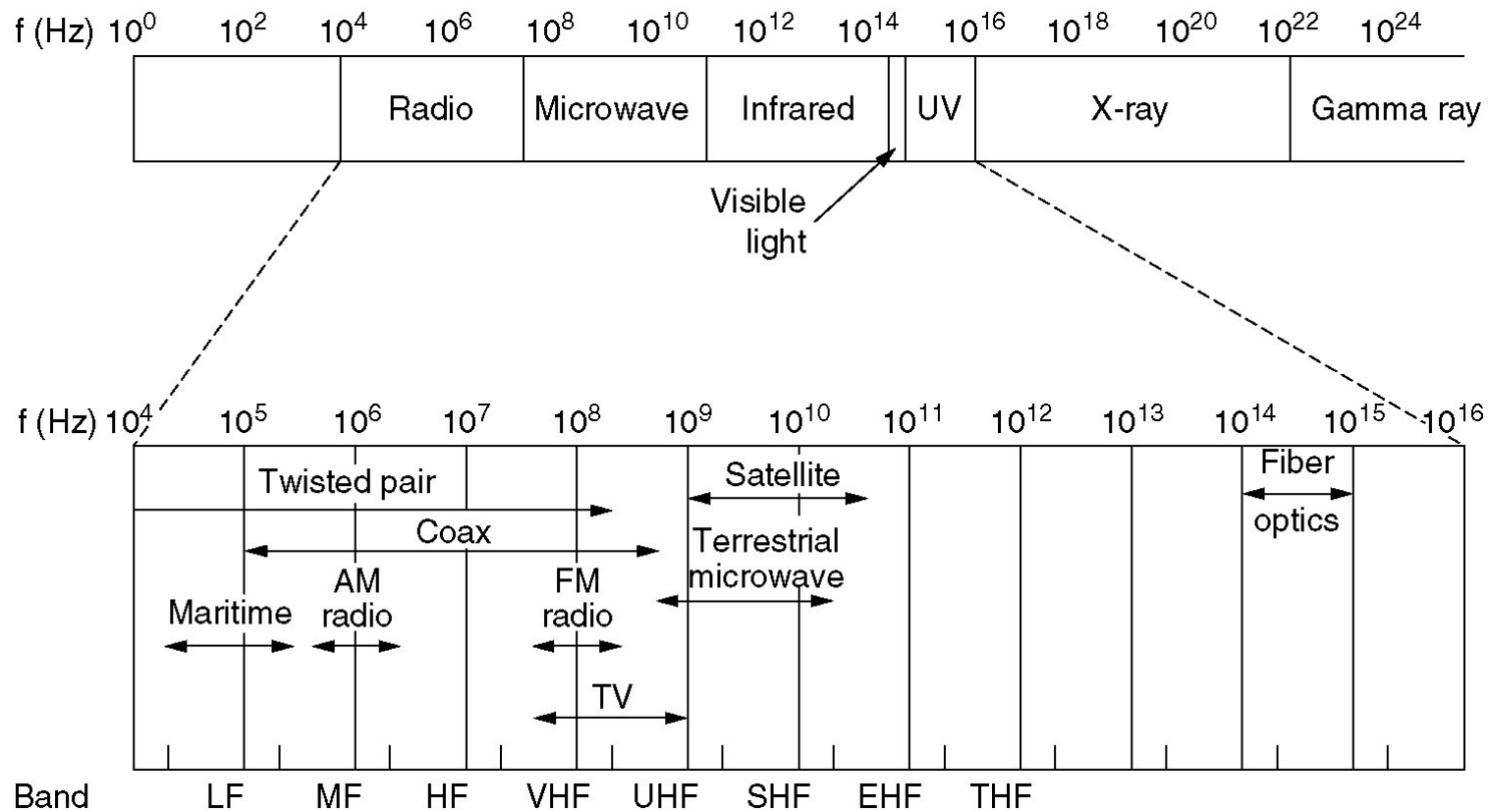


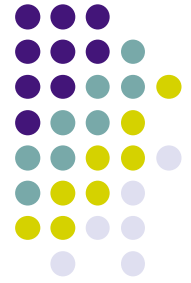


# Wireless media

- Microwave: 1GHz đến 40GHz
- Radio: 30MHz đến 1GHz
- Infrared: 300GHz đến 200 THz
- Antenna: wireless transceiver

# Frequency range of transmission channels



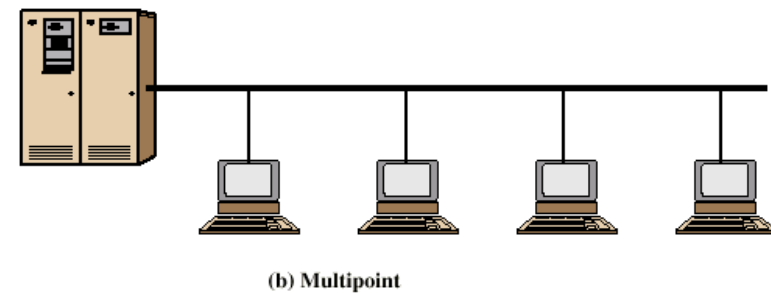
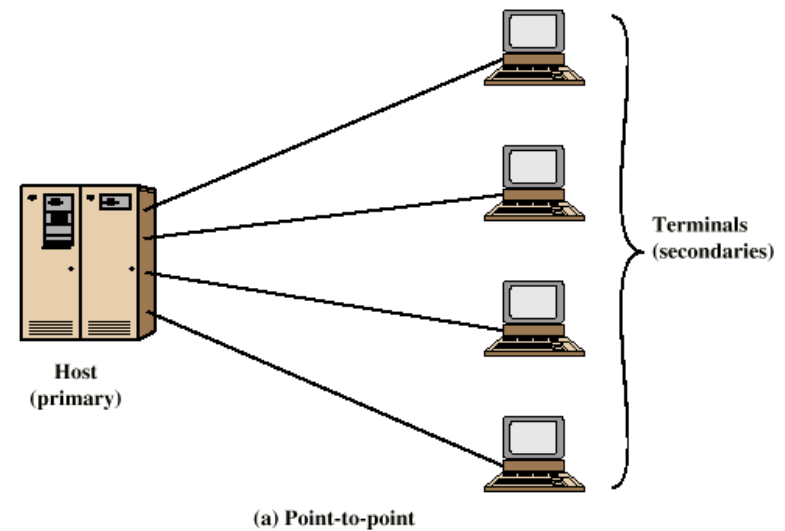


# Data encoding

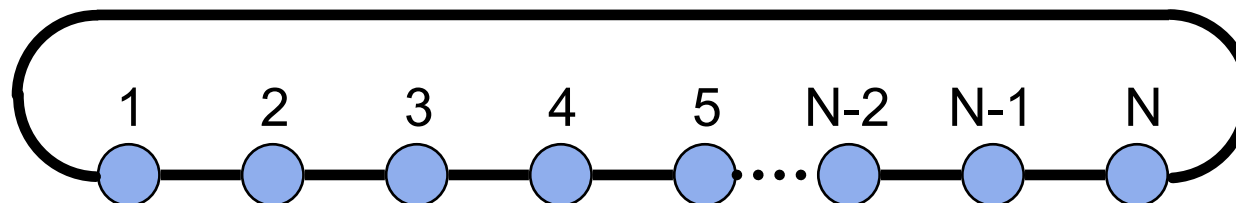
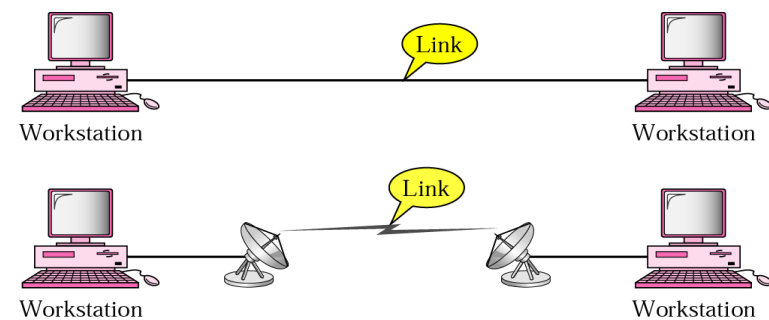
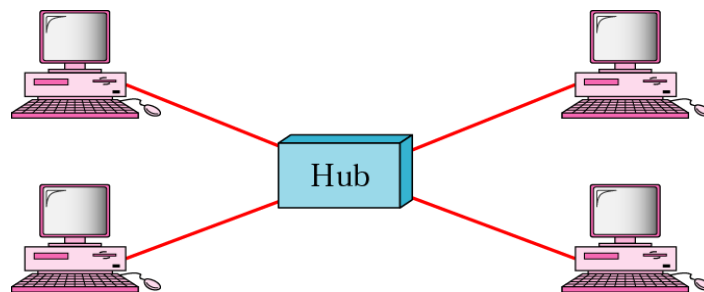
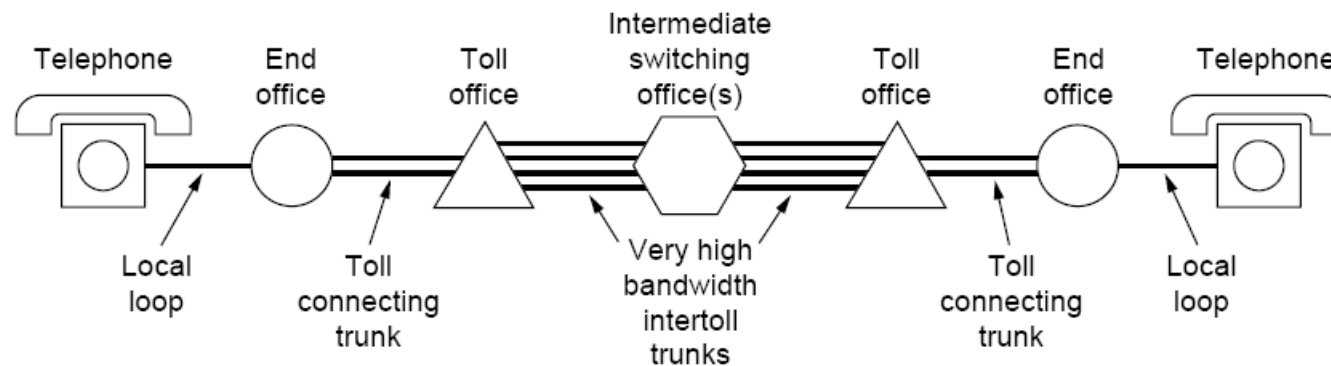
- Use different discrete signal, different voltage level for representing bit 0 and 1.
- Data transmission should be synchronized between sender and receiver: clock synchronization
- Encoding could be performed by bit or by a group of bit e.g., 4 or 8 bits.
- There are many way to represent 0 and 1 → See data transmission technique.

# Topology

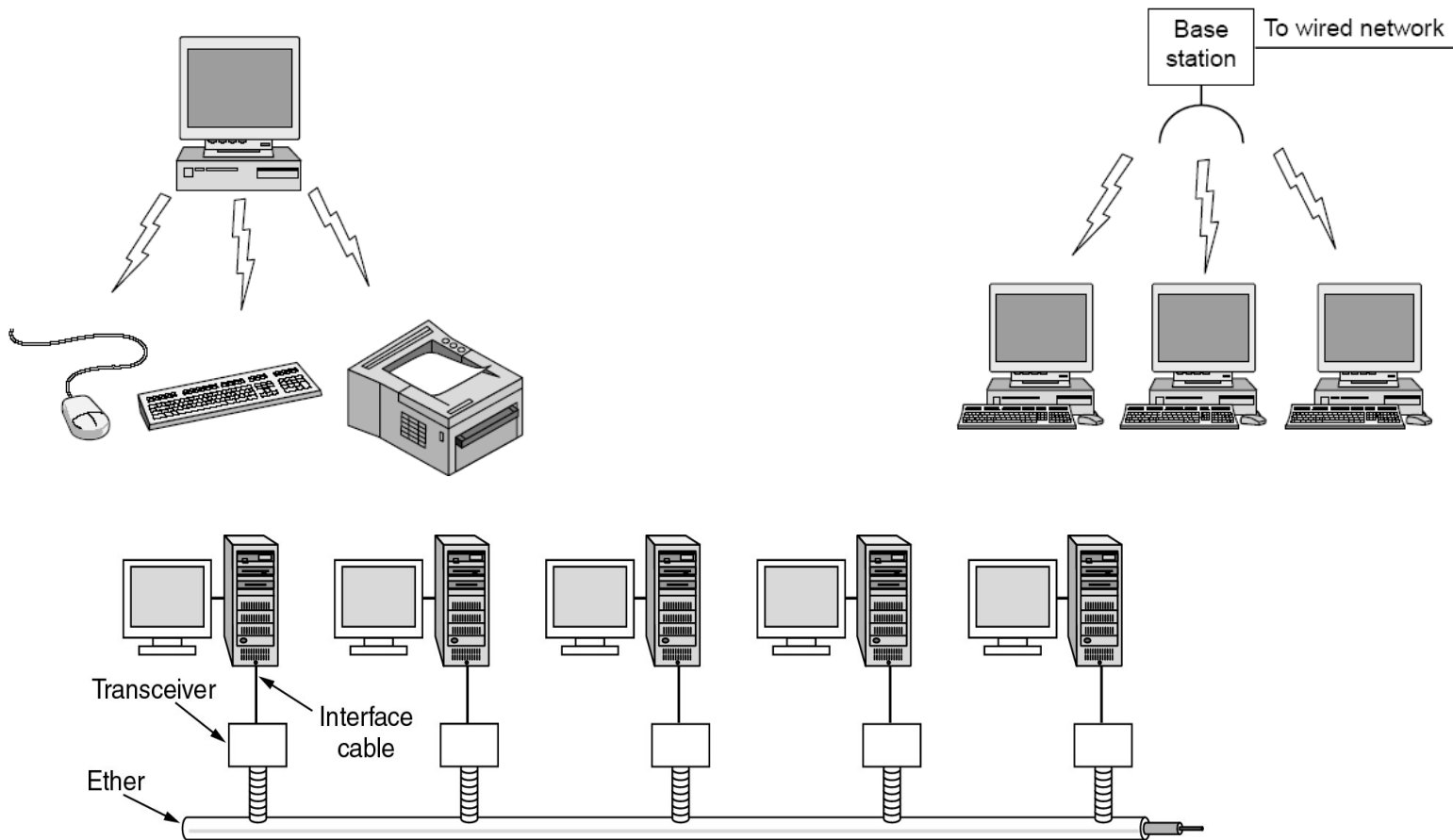
- Point-to-point
  - Star
  - Ring
  - Mesh
- Point-to-multipoint
  - Bus
  - Ring
  - Star



# Point-to-Point



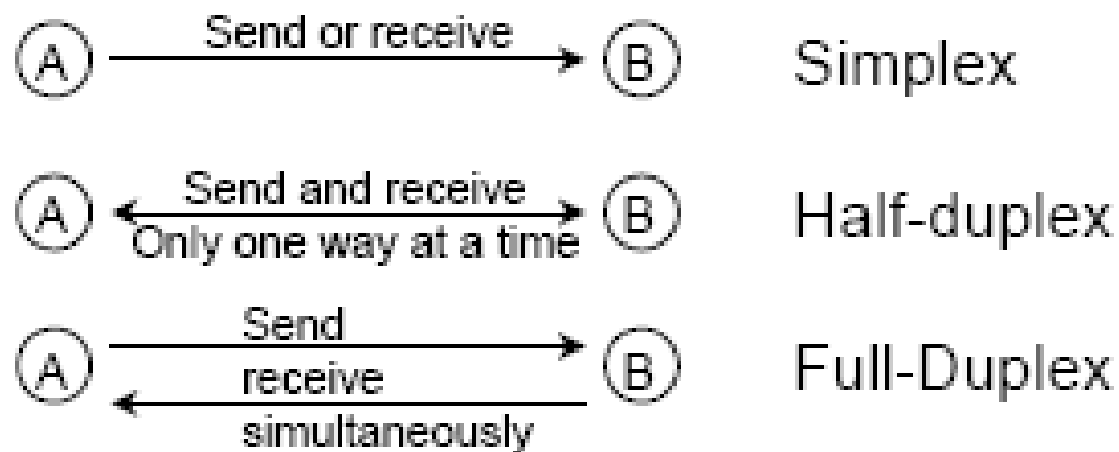
# Point-to-multipoint

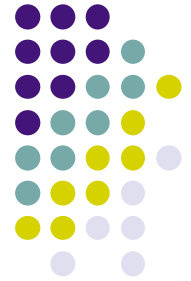




# Transmission methods

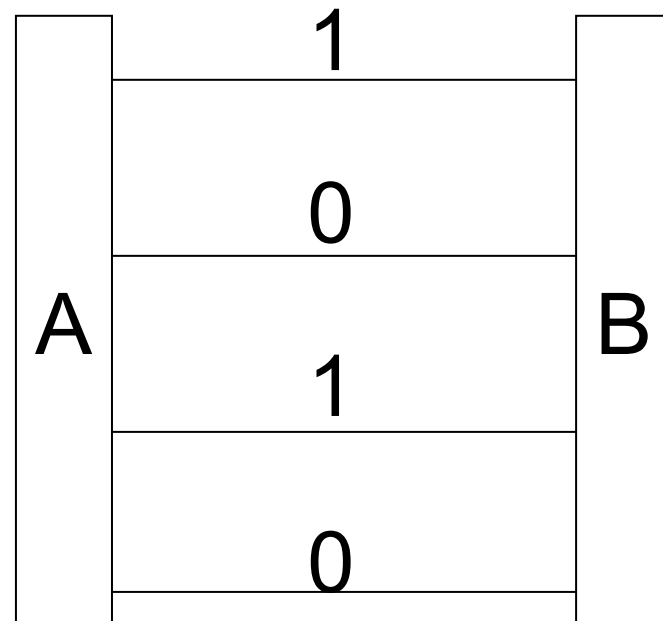
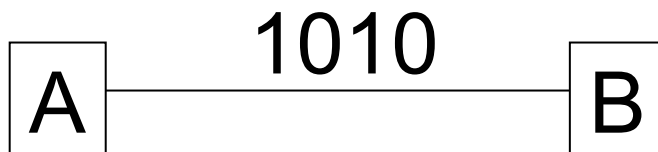
- Simplex: Data is transmitted in one direction
- Full Duplex: Data can be transmitted in both directions in the same time
- Half duplex: Data can be transmitted in both directions but one direction at a time.



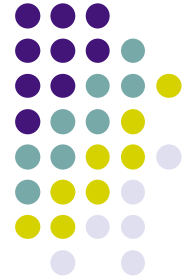


# Transmission format

- Sequent transmission: Transmit 1 bit at a moment (over a signal line)
- Parallel transmission: Trasmit multiple bits in the same time (over multiple signal lines)



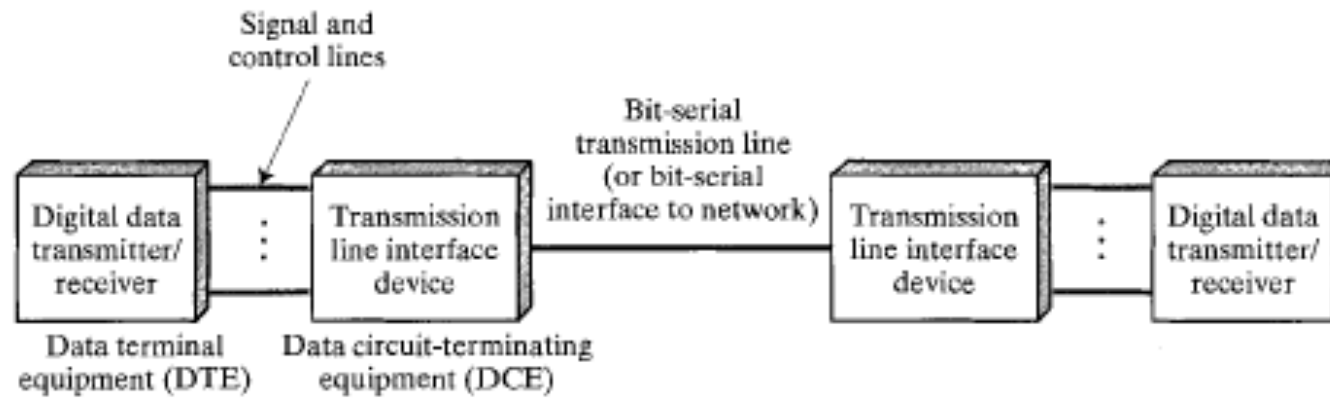




# Medium interface

- Data terminal equipment (DTE)
  - Have data to transmit but has no feature for transmission
  - Need an additional device for accessing the media
- Data circuit terminating equipment (DCE)
  - Transmit bits on the media
  - Transmit data and control information with DCE through connection the media
- Need a clear interface standard between DTE, DCE

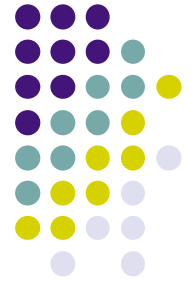
# DTE-DCE



(a) Generic interface to transmission medium

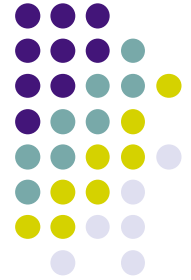


(b) Typical configuration



# Media interface

- Mechanism
  - Define the form of the interface, number of pins for assuring the interfaces match together
- Electrics
  - Define the level of voltage to be used
  - Define the length of pulse (frequency)
  - Define encoding method
- Functionalities
  - Functionality of each pins
  - There are 4 groups of pins: data, control, synchronization, ground
- Procedure
  - Lists of events to perform for transmitting data



## Example: V.24 /EIA-232-E

- Define for serial communication
- Mechanism: ISO 2110
- Electrics: V. 28
- Functionality: V. 24
- Procedure: V. 24

# Example: V.24 /EIA-232-E



- Mechanic:
  - 25 or 15 pins
  - Transmission distance 15m
- Electrics
  - Digital data
  - 1=-3v, 0=+3v (NRZ-L)
  - Data rate 20kbps
  - Transmission distance< 15m

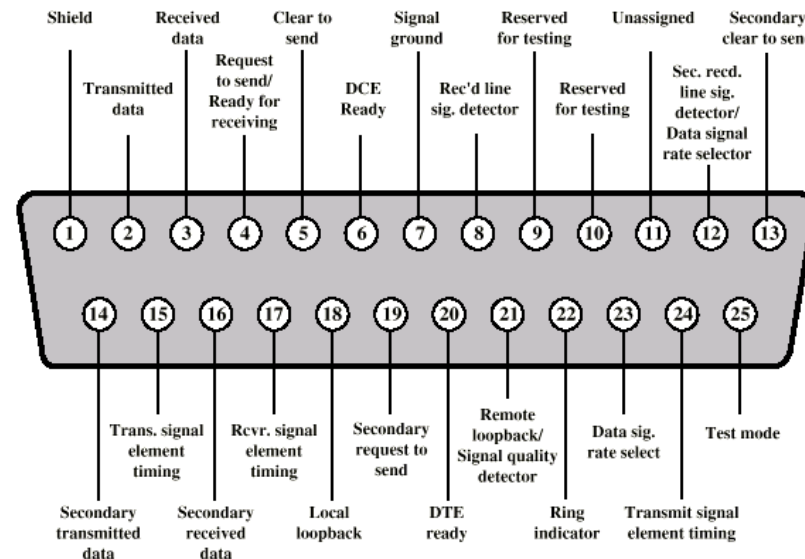


Figure 6.5 Pin Assignments for V.24/EIA-232 (DTE Connector Face)