IT 4505
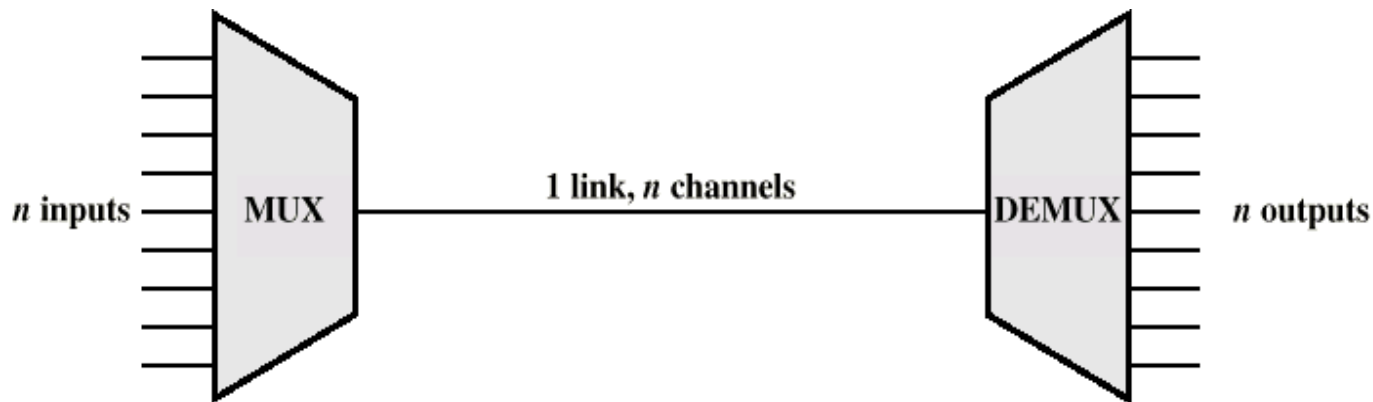# Section 1.3

Data Transmission Concepts

1.3 Multiplexing

Multiplexing allows several transmission sources to share a larger transmission capacity.

The two common forms of multiplexing are frequency division multiplexing (FDM) and time division multiplexing (TDM).
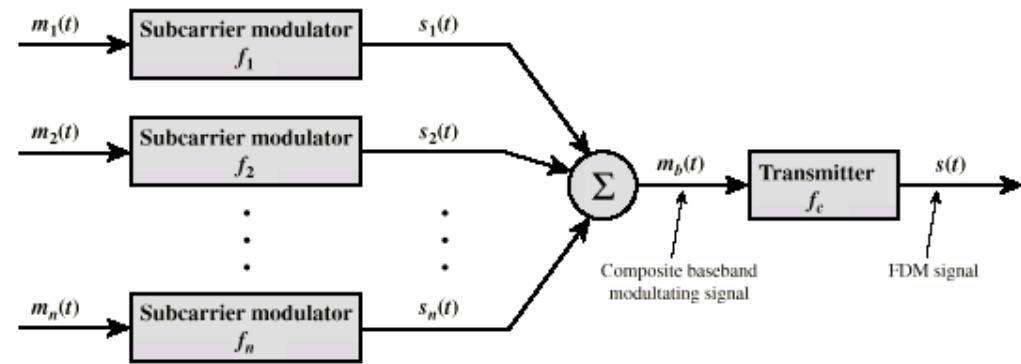
1.3.1 Frequency Division Multiplexing

❑ Useful bandwidth of medium exceeds required bandwidth of channel

❑ Each signal is modulated to a different carrier frequency

❑ Carrier frequencies are separated so signals do not overlap (guard bands)

      e.g. broadcast radio

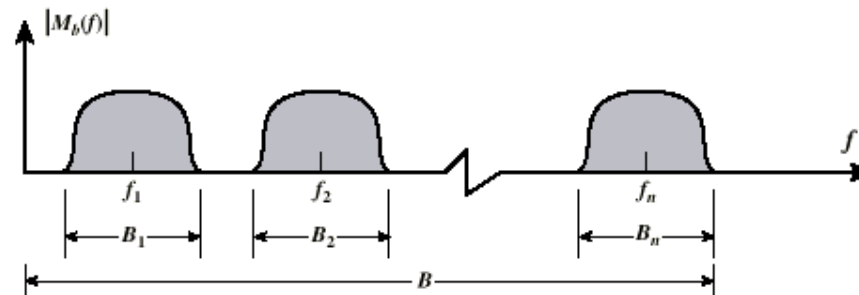❑ Channel allocated even if no data
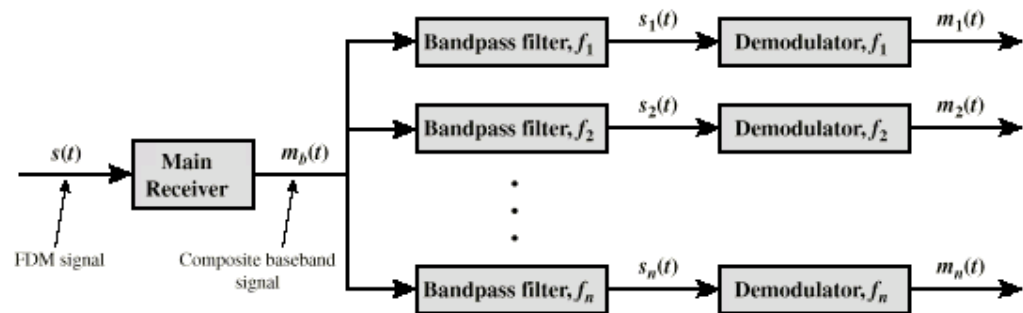
Frequency Division Multiplexing Diagram
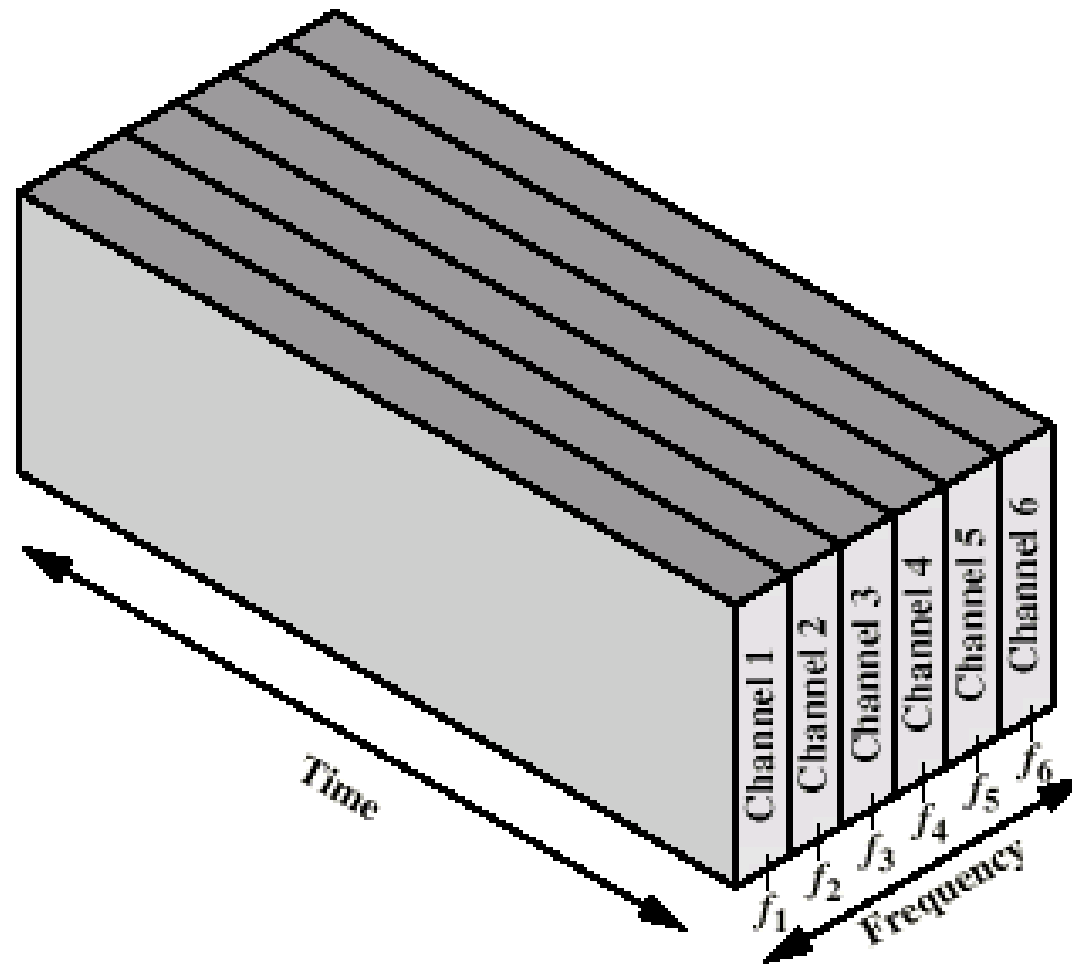
FDM System

(a) Transmitter

(b) Spectrum of composite baseband modulating signal

(c) Receiver

1.3.2 Synchronous Time Division Multiplexing

❑ Data rate of medium exceeds data rate of digital signal to be transmitted.

❑ Samples of Multiple digital signals interleaved in time.

❑ May be at bit level or as blocks.

❑ Time slots preassigned to sources and fixed.

❑ Time slots allocated even if no data.

❑ Time slots do not have to be evenly distributed amongst sources.

❑ Good for continuous data (or digital information from analogue source).
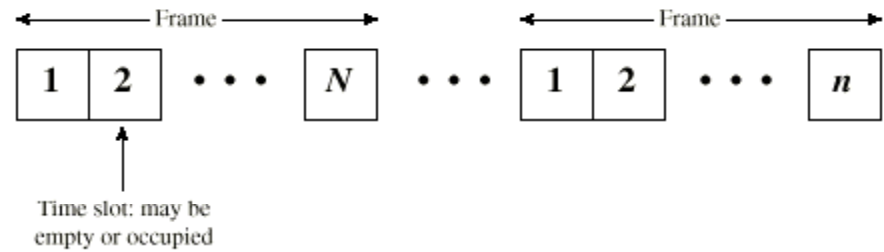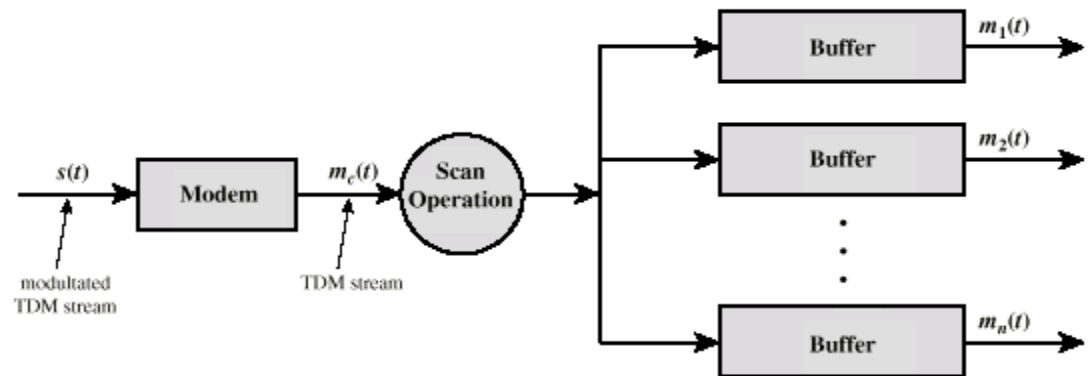
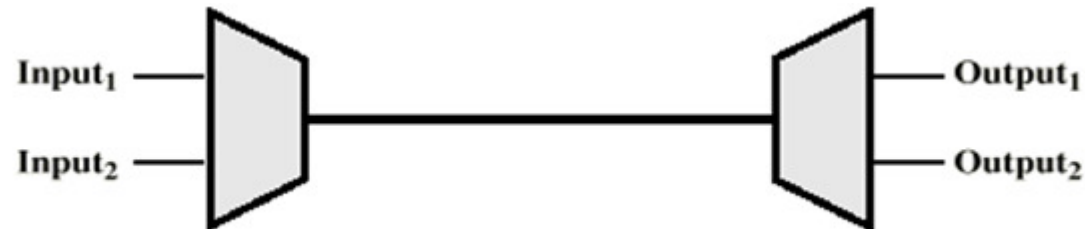# Time Division Multiplexing
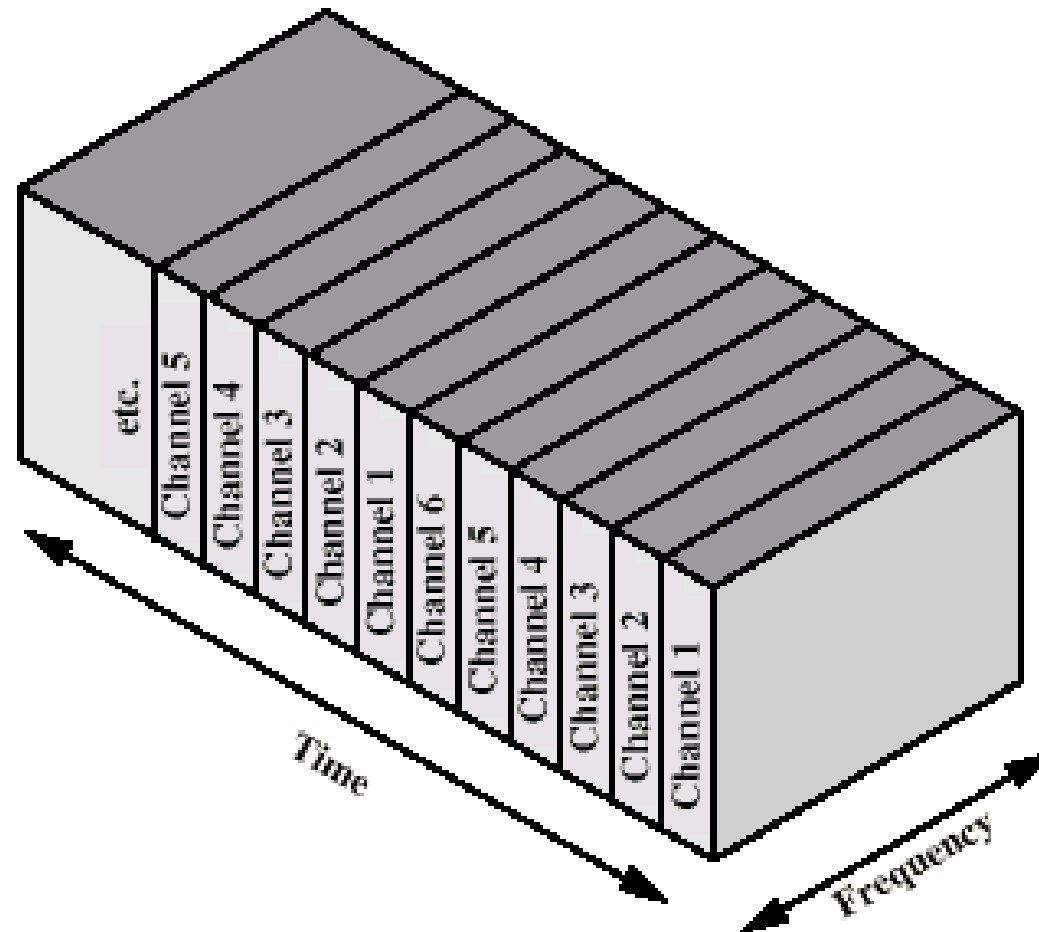
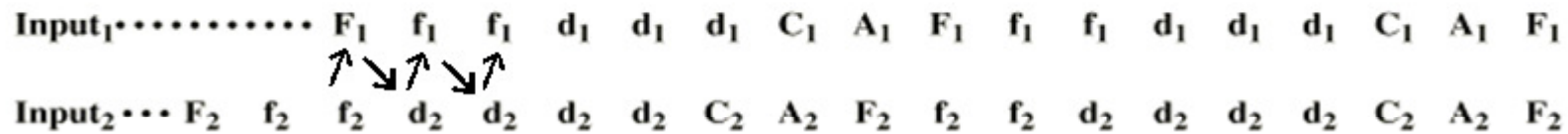# TDM System
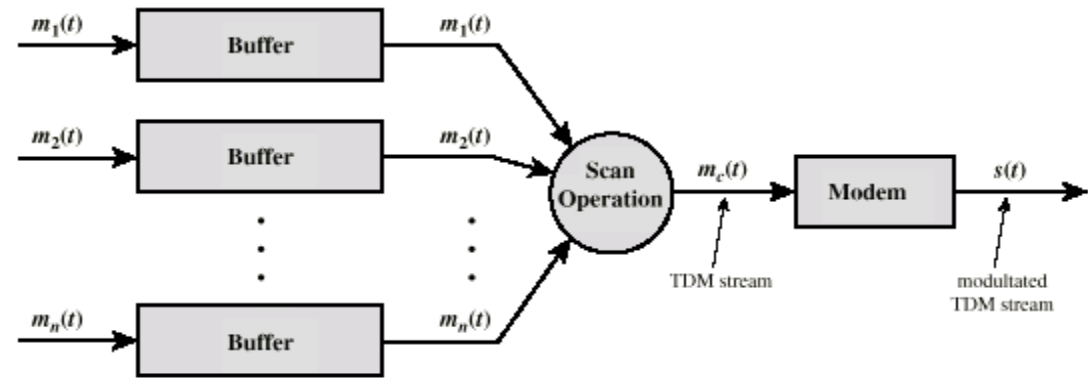
(a) Transmitter

(b) TDM Frames

(c) Receiver

Data Link Control on TDM

(a) Configuration

Input₁ · · · · · · · · · · · · F_1 f_1 f_1 d_1 d_1 d_1 C_1 A_1 F_1 f_1 f_1 d_1 d_1 d_1 C_1 A_1 F_1

Input₂ · · · F_2 f_2 f_2 d_2 d_2 d_2 d_2 C_2 A_2 F_2 f_2 f_2 d_2 d_2 d_2 d_2 C_2 A_2 F_2

(b) Input data streams

· · · f_2 F_1 d_2 f_1 d_2 f_1 d_2 d_1 d_2 d_1 C_2 d_1 A_2 C_1 F_2 A_1 f_2 F_1 f_2 f_1 d_2 f_1 d_2 d_1 d_2 d_1 d_2 d_1 C_2 C_1 A_2 A_1 F_2 F_1

(c) Multiplexed data stream

Legend: F = flag field   d = one octet of data field
         A = address field   f = one octet of FCS field
         C = control field

Framing

❑ No flag or SYNC characters bracketing TDM frames

❑ Must provide synchronizing mechanism

❑ Added digit framing

- One control bit added to each TDM frame

  o Looks like another channel - "control channel"

- Identifiable bit pattern used on control channel
  e.g. alternating 01010101…unlikely on a data channel

- Can compare incoming bit patterns on each channel with sync pattern

1.3.3 Statistical Time Division Multiplexing

❑ In Synchronous TDM many slots are wasted , if no data to send is available.

❑ Statistical TDM allocates time slots dynamically based on data demand.

❑ Multiplexer scans input lines and collects data until frame full.

❑ Data rate on line lower than aggregate rates of input lines

❑ Each data sample must have a identification label (source / destination address).
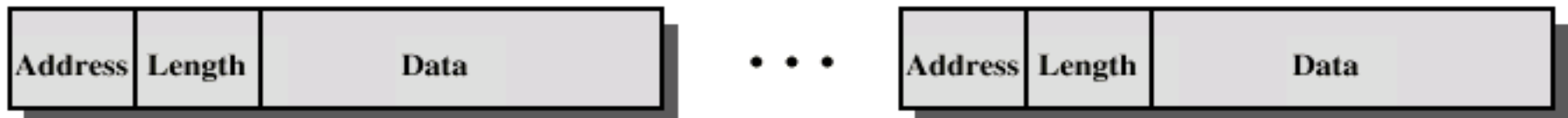
❑ Good for packet data.

Statistical TDM Frame Formats

Flag	Address	Control	Statistical TDM subframe	FCS	Flag

(a) Overall frame

Address	Data

(b) Subframe with one source per frame

Address	Length	Data	• • •	Address	Length	Data

(c) Subframe with multiple sources per frame