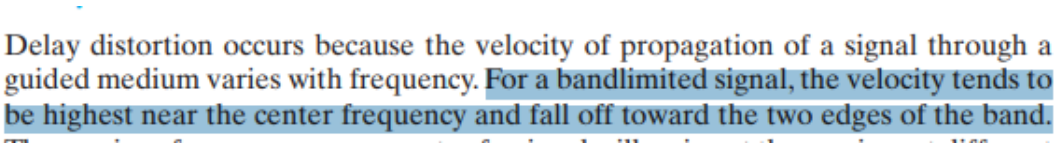
Final 2019

Q.1

A)

1. True
2. False,


Delay distortion occurs because the velocity of propagation of a signal through a guided medium varies with frequency. For a bandlimited signal, the velocity tends to be highest near the center frequency and fall off toward the two edges of the band.

3. False, a lack of high frequency component means less bandwidth is required
4. True
5. True
6. True(not sure)
7. False, use error-correction technique as the propagation time take a while
8.
9. True
10. True

B)

$$60 * 10 - 20 = 10 \log(\frac{p_{out}}{0.5})$$
$$p_{out} = 5kW$$

Q.2

A)

- `Guided`
  - transition occurs through a physical path
  - Supports point to point communication
  - e.g., twisted pairs, coaxial cables, and optical fibers
  - Local computer network, LANs, subscriber networks
- `Unguided`
  - provides a means for transmitting the waves but not to guide them
  - Wireless communication
  - e.g, radio, and microwave
  - GPS, TV distribution

B)

bandwidth, a given signal power, and in the presence of noise.

3.20 **a.** Using Shannon's formula $C = 10^6 \log_2(1 + 63) = 6$ MHz.
b. Data rate = 4 MHz. Using Nyquist's formula $4 \times 10^6 = 2 \times 10^6 \log_2 M$
$M = 2^2 = 4$

Q.3

A)

- `NRZ`
  - The easiest to engineer
  - Make efficient use of bandwidth
  - has dc component
  - lacks synchronization capability
- `Multilevel binary`
  - less band width than NZR
  - no dc component

- supports synchronization
- provides simple means of error detection

- `Biphase(Manchester & differential Manchester)`
  - greater bandwidth than NZR yet narrower
  - No dc component
  - provides simple means of error detection

- `Scrambling`
  - No dc component
  - No long sequences of zero-level line
  - No reduction in data
  - Error-detection capability

B)

i.

6.6 In worst-case conditions, the two clocks will drift in opposite directions. The resultant accuracy is 2 minutes in 1 year or:
$2/(60 \times 24 \times 365) = 0.0000038$
The allowable error is 0.4
Therefore, number of bits is $0.4/0.0000038 = 105{,}000$ bits

ii. won't change

6.6 Suppose that a synchronous serial data transmission is clocked by two clocks (one at the sender and one at the receiver) that each have a drift of 1 minute in one year. How long a sequence of bits can be sent before possible clock drift could cause a problem? Assume that a bit waveform will be good if it is sampled within 40% of its center and that the sender and receiver are resynchronized at the beginning of each frame. Note that the transmission rate is not a factor, as both the bit period and the absolute timing error decrease proportionately at higher transmission rates.

Q.4

A)

- Stop-and-wait ARQ
  - Simple yet inefficient
  - The source transmits a single frame and await `ACK`, two forms of errors could happen
    - damaged frame
      - If no ack is received after timeout, the frame is resent
      - a copy of the transmitted frame must be maintained by the transmitter until ack is received
    - damaged ack
      - the transmitter will time out and resend the same frame
      - duplicate transmission of frames exist, so frames are alternately labeled with 1, 0
- Go-back-N ARQ
  - Based on sliding-window flow control
  - The station may send a series of frames sequentially numbered, three forms of error could happen
    - damage frame
    - damage RR
    - damage REJ
- Selective-reject ARQ
  - More efficient yet more complex than Go-back-N ARQ
  - The only frames retransmitted are those that receive a negative ack
  - used in satellites because of the long propagation delays

B)

Q.5

A)

1. ADSL Strategy
    - uses frequency division multiplexing
    - reserves the lowest $25KHz$ for voice, POTS(plain old telephone service). The voice is carried only in the $0-4KHz$ band; the additional bandwidth is to prevent cross-talk between the voice and the data channels
    - uses two echo cancellation or FDM to allocate two bads
        - smaller upstream band
        - larger downstream band
    - uses FDM within the upstream and downstream bands. In this case, a single bitstream is split into multiple parallel bitstreams and each portion is carried in a separate frequency band.
2. ADSL channel configuration

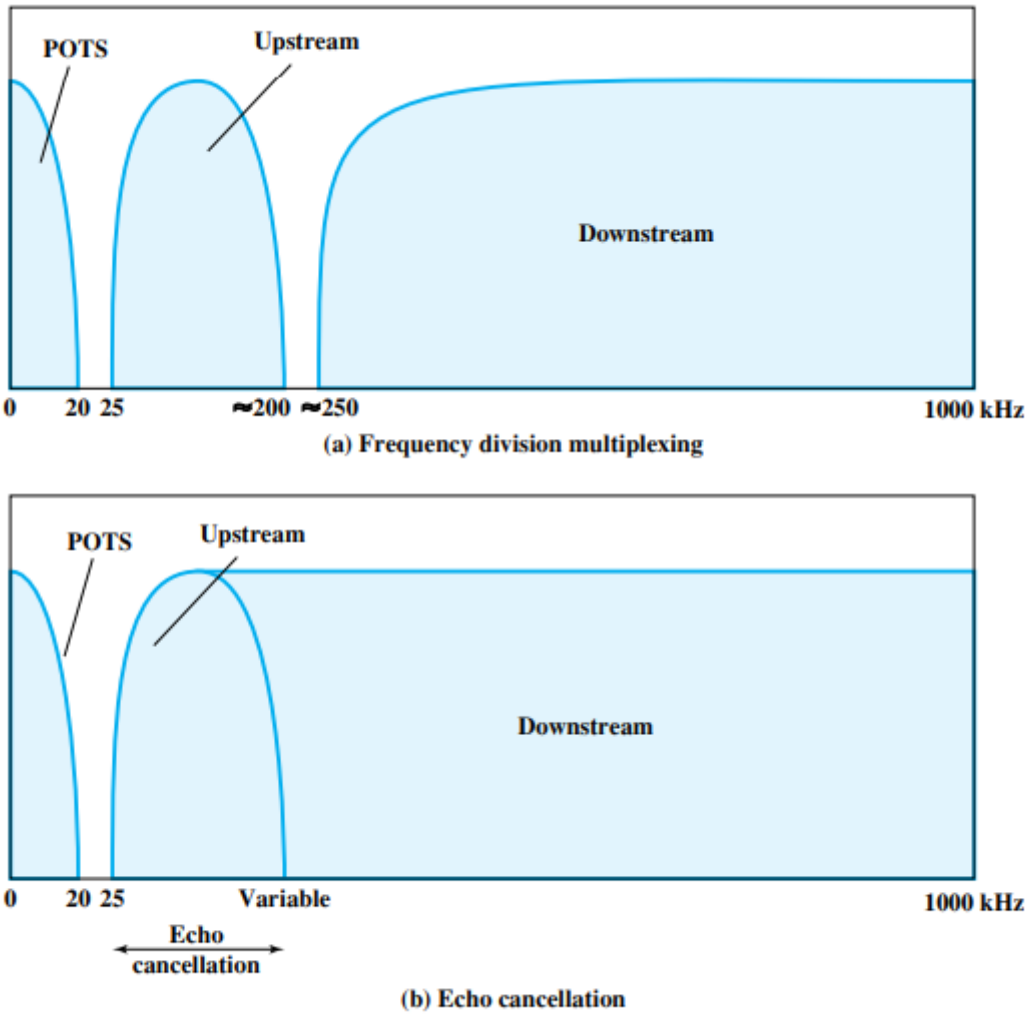


Figure 8.17 ADSL Channel Configuration

3. DMT

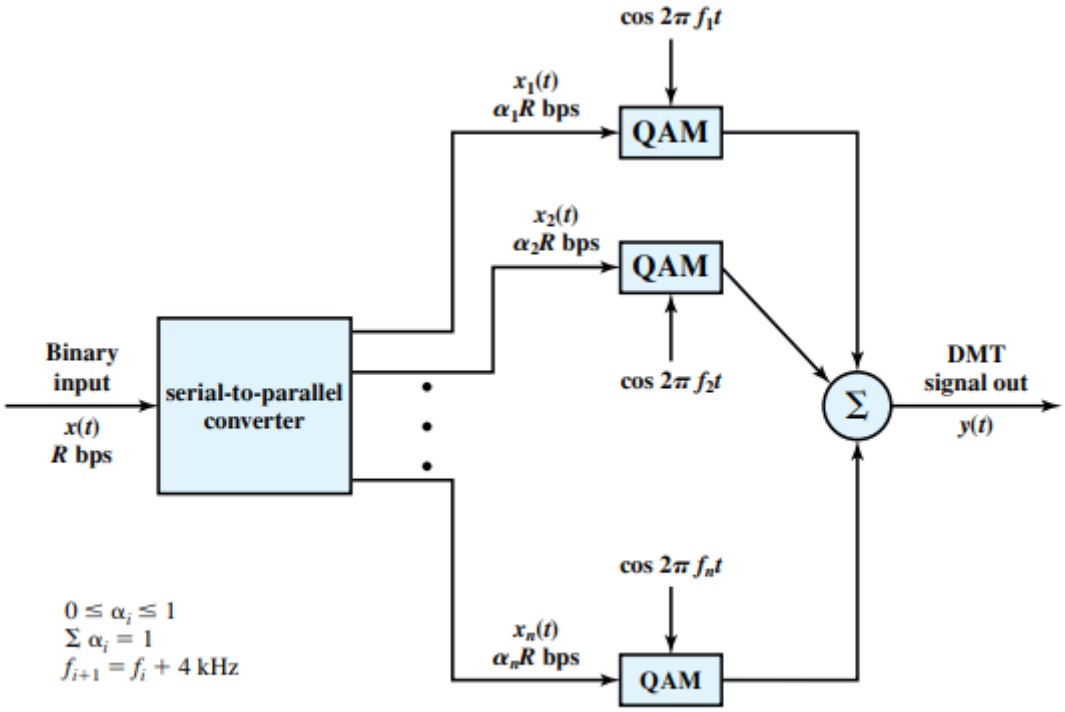


Figure 8.19 DMT Transmitter

B)

Ten 4-KHz voice signals are sampled at the minimum sampling rate and encoded using 8 bit encoder to be multiplexed in byte-interleaving fashion using TDM.

i. Data rate of each source = 2 x 4000 x 8
= 64000 bps
The scanning speed = 64000/8
= 8000 cycle/sec

ii. Length of the frame = 10 x 8 + 1
= 81 bits
The data rate of the resulted TDM signal = 81 x 8000
= 648000 bps

iii. Time duration of one bit = 1/648000
= 1.54 x 10^{-6} sec
Time duration of the voice channel = 8 x 1.54 x10^{-6}
= 12.34 μsec.

iv. The maximum time of the frame synchronization = 81 x 30 x 1.54 x 10^{-6}
= 3.75 msec.