Homework #2 - Jader Ricarte

Introduction to Data Communication and Networking (De Anza College)

Jader E. Ricarte

Chapter 4 – P. 131

P 4-2

In a digital transmission, the sender clock is 0.2 percent faster than the receiver clock. How many extra bits per second does the sender send if the data rate is 1 Mbps?

Answer: Given, sender clock faster = 0.2% = 0.2/100 = 0.002

The Data rate = 1 Mbps = 10^6

Extra bits = 0.002 x 10^6 = 0.002 x 1,000,000 = 2000

P 4-6

Repeat Problem P4-3 for the differential Manchester scheme.

Answer: Average number of changes = (16 + 8 +12 +12) / 4 = 12 for N = 8

Bandwidth B (12 / 8) N

P 4-10

An NRZ-I signal has a data rate of 100 Kbps. Using Figure 4.6, calculate the value of the normalized energy (P) for frequencies at 0 Hz, 50 KHz, and 100 KHz.

Answer: The data rate is 100 Kbps. For each case, we first need to calculate the value of f / N. We then use figure 4.6 in the text to find P (energy per Hz).

A. f / N = 0/100 = 0 P = 1.0
B. f / N = 50/100 = 1/2 P = 0.5
C. f / N = 100/100 = 1 P = 0.0

P 4-12

The input stream to a 4B/5B block encoder is 0100 0000 0000 0000 0000 0001

Answer the following questions:

a. What is the output stream?

b. What is the length of the longest consecutive sequence of 0s in the input?

c. What is the length of the longest consecutive sequence of 0s in the output?

Answer:

A. Output stream will is 01010 11110 11110 11110 11110 01001
B. The length of the longest consecutive sequence of 0s in the input is 21.

C. The length of the longest consecutive sequence of 0s in the output is 2.

P 4-17

What is the maximum data rate of a channel with a bandwidth of 200 KHz if we use four levels of digital signaling.

Answer: Bandwidth = 200 KHz = 200000 Hz

Maximum data rate is calculated as $N_{max} = 2 \times B \times nb = 2 \times 200000 \times \log 4 = 8 \times 10^8$ bps = 800 Kbps

Chapter 5 – P.153

P 5-2

Calculate the bit rate for the given baud rate and type of modulation.

a. 1000 baud, FSK

b. 1000 baud, ASK

c. 1000 baud, BPSK

d. 1000 baud, 16-QAM

Answer: The formula that we need to use is N= r x S, but we need to calculate the value of r for each case.

A. r = log22 = 1 → N = (1) × (1000 bps) = 1000 bps

B. r = log22 = 1 → N = (1) × (1000 bps) = 1000 bps

C. r = log22 = 1 → N = (1) × (1000 bps) = 1000 bps

D. r = log216 = 4 → N = (4) × (1000 bps) = 4000 bps

P 5-8

The telephone line has 4 KHz bandwidth. What is the maximum number of bits we can send using each of the following techniques? Let d = 0.

a. ASK = (HDS

b. QPSK

c. 16-QAM

b. 64-QAM

Answer: We need to use the formula N = [1/(1 + d)] × r × B, but first we need to calculate the value of r for each case.

A. r = log22 = 1 → N= [1/(1 + 0)] × 1 × (4 KHz) = 4 kbps

B. r = log24=2 → N = [1/(1 + 0)] × 2 × (4 KHz) = 8 kbps

C. r = log216= 4 → N = [1/(1 + 0)] × 4 × (4 KHz) = 16 kbps

D. r = log264= 6 → N = [1/(1 + 0)] × 6 × (4 KHz) = 24 kbps

P 5-10

A cable company uses one of the cable TV channels (with a bandwidth of 6 MHz) to provide digital communication for each resident. What is the available data rate for each resident if the company uses a 64-QAM technique?

Answer: We can use the formula: N = [1/(1 + d)] × r × B = 1 × 6 × 6 MHz = 36 Mbps

P 5-12

Find the total number of channels in the corresponding band allocated by FCC.

a. AM

b. FM

Answer:

A. According to the FCC Bandwidth (5 KHz),
AM Bandwidth is 10 KHz per channel.
Carrier frequency of AM stations between 530 KHz to 1700 KHz
.'. Number of channel, n = (1700-530) / 10 = 117

B. According to FCC, FM bandwidth is 200 KHz per channel
Carrier frequency of FM stations between 88 MHz to 108 MHz
.'. Number of channel, n = (108-88) MHz / 200 KHz = 20 MHz / 200 KHz = 100

Chapter 6 – P. 182

P 6-2

We need to transmit 100 digitized voice channels using a passband channel of 20 KHz. What should be the ratio of bits/Hz if we use no guard band?

Answer: The bandwidth allocated to each voice channel, B= 20 KHz / 100 = 200 Hz

We know that, data rate of each digitized voice channel = 64 Kbps.

Modulation technique uses the ratio of, 64 K bps / 200 = 64000/200 = 32 bits/Hz

P 6-4

We need to use synchronous TDM and combine 20 digital sources, each of 100 Kbps. Each output slot carries 1 bit from each digital source, but one extra bit is added to each frame for synchronization. Answer the following questions:

a. What is the size of an output frame in bits?

b. What is the output frame rate?

c. What is the duration of an output frame?

d. What is the output data rate?

e. What is the efficiency of the system (ratio of useful bits to the total bits)?

Answer:

A. Number of digital source = 20 ; Output slots carries = 1 bit ; Synchronizing extra bit = 1
   Frame size = 20 x 1 + 1 = 21 bits
B. Each frame carries 1 bit from each source. Source bandwidth = 100 Kbps = 100000 bps
   Frame rate = 100000 frame/s.
C. Frame duration = 1 / frame rate = 1 / 100000 = 10^{-5} s = 10 us
D. Data rate = frame rate x frame size = 100000 x 21 = 2.1 Mbps
E. In each frame 20 bits out of 21 are useful. Efficiency = 20 / 21 x 100 = 95%

P 6-6

We have 14 sources, each creating 500 8-bit characters per second. Since only some of these sources are active at any moment, we use statistical TDM to combine these sources using character interleaving. Each frame carries 6 slots at a time, but we need to add 4-bit addresses to each slot. Answer the following questions:

a. What is the size of an output frame in bits?

b. What is the output frame rate?

c. What is the duration of an output frame?

d. What is the output data rate?

Answer:

A. Given, per second = 8 bit, add more 4 bit frame carries = 6 slots

Frame size = 6 x (8 + 4) = 72 bits.

B. Number of slot = 6, which means 6 input lines.

Each frame needs to carry 1 character (8 bit) from each of these lines

Frame rate = 500/ 1 = 500 frame/s

C. Frame duration = 1/ frame rate == 1/500 = 2 x 10^{-3} s = 2 ms

D. Data rate = frame rate x frame size = 500 x 72 = 36 kbps.

P 6-10

Answer the following questions about a T-1 line:

a. What is the duration of a frame?

b. What is the overhead (number of extra bits per second)?

Answer:

A. T-1 line sends 8000 frame/s

Frame duration = 1 / framerate = 1/8000 = 125 us.

B. Each frame carries one extra bit

Overhead = 8000 x 1 = 8 kbps

P 6-16

An FHSS system uses a 4-bit PN sequence. If the bit rate of the PN is 64 bits per second, answer the following questions:

a. What is the total number of possible channels?

b. What is the time needed to finish a complete cycle of PN?

Answer:

A. 2^4 = 16 hops

B. (64 bits/s) / 4 bits = 16 cycle/s