TCOM 500: Modern Telecommunications
Prof. Paris

Solution for HW 8

I made a typo on this assignment, I had meant to assign 7.12 and 7.18, not 4.12 and 4.18. I give you solutions for both. Also, I had meant to strip off part (a) from the last problem.

1. Problem 4.12

We mentioned ***synchronous***, ***asynchronous***, and ***isochronous***. In both synchronous and asynchronous transmissions, a bit stream is divided into independent frames. In synchronous transmission, the bytes inside each frame are synchronized; in asynchronous transmission, the bytes inside each frame are also independent. In isochronous transmission, there is no independency at all. All bits in the whole stream must be synchronized.

Problem 7.12

Table 7.1

Distance	dB at 1KHz	dB at 10KHz	dB at 100KHz
1km	1.0	1.2	2.2
10km	10	12	22
20km	20	24	44

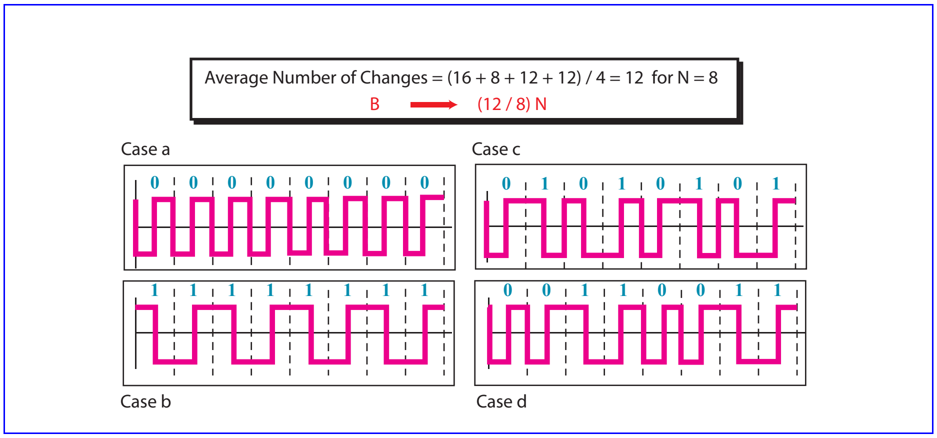
As the Table 7.1 shows, for a specific maximum value of attenuation, the highest frequency decreases with distance. If we consider the bandwidth to start from zero, we can say that the bandwidth decreases with distance. For example, if we can tolerate a maximum attenuation of 20 dB (loss), then we can give the following listing of distance versus bandwidth.

Distance	**Bandwidth**
1 Km	very large
10 Km	100 KHz
20 Km	10 KHz

2. Problem 4.18

See Figure 4.4. B is proportional to **(12/8) N** which is within the range in Table 4.1 (B = N to 2N) for the differential Manchester scheme.

Figure 4.4 *Solution to Exercise 18*



Problem 7.18

a. The ***wave length*** is the ***inverse*** of the ***frequency*** if the propagation speed is fixed (based on the formula $\lambda = c / f$). This means all three figures represent the same thing.

b. We can change the wave length to frequency. For example, the value 1000 nm can be written as 200 THz.

c. The vertical-axis units may not change because they represent dB/km.

d. The curve must be flipped horizontally.

3. Problem 7.13

We can use Table 7.1 to find the power for different frequencies:

1KHz	dB=–3	$P2 = P1 \times 10^{-3/10}$	=**100.23mw**
10KHz	dB=–5	$P2 = P1 \times 10^{-5/10}$	=**63.25mw**
10KHz	dB=–7	$P2 = P1 \times 10^{-7/10}$	=**39.90mw**

4. Problem 7.16

Table 7.2 *Solution to Exercise 14*

Distance	*dB at 1 KHz*	*dB at 10 KHz*	*dB at 100 KHz*
1 Km	**−3**	**−7**	**−20**
10 Km	**−30**	**−70**	**−200**
15 Km	**−45**	**−105**	**−300**
20 Km	**−60**	**−140**	**−400**

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1KHz	dB=–3	$P2 = P1 \times 10^{-3/10}$	=**100.23mw**
10KHz	dB=–7	$P2 = P1 \times 10^{-7/10}$	=**39.90mw**
10KHz	dB=–20	$P2 = P1 \times 10^{-20/10}$	=**2.00mw**

5.

b. Link Budget: $SNR_{dB} = P_{t,dBm} - L_{p,dB} - N_{0,dBm/Hz} - B_{dBHz}$. Values for all but $L_{p,dB}$ are given and $L_{p,dB}$=134dB results. From the expression for the path loss one finds $d = 10^{94/30} \approx 1000$m.

c. For d=2km, path loss is $L_{p,dB}$=139dB. This is 5dB more than in part b, which must be

made up by a 5dB increase in transmit power to $P_{t,dB}$ = 35dBm ≈ 3W.
d. If bandwidth is reduced by a factor of 10, the right hand side of the link budget increases by 10dB. Therefore, the path loss can increase by 10dB. This allows the distance to increase by a factor of $10^{10/30} \approx 2$.