第二次作业

第二次作业：（英文版教材第二章2, 3, 4, 7, 8, 21, 24, 25, 26, 28, 37, 教材第四章14）

2. A noiseless 8–kHz channel is sampled every 1 msec. What is the maximum data rate?

解：

$$\text{因为每毫秒采样1000次所以波特率} == 1000$$
$$\text{若每次采样产生16位数据，则}maximumdatarate\text{为}16kbps.$$
$$\text{若每次采样产生1024位数据，则}maximumdatarate\text{为}1.024Mbps.$$

3. If a binary signal is sent over a 3–kHz channel whose signal–to–noise ratio is 20 dB, what is the maximum achievable data rate?

奈奎斯特公式:

$$maximum\ data\ rate = 2 \times B \times \log_2 V = 6kbps$$

Shannel's theorem:

$$\text{由}20dB\text{可得}SNR = 100$$
$$C = B \times \log_2(1 + SNR) \approx 19.97kbps$$

所以 the maximum achievable data rate is 6 kbps

4. What signal–to–noise ratio is needed to put a T1 carrier with data rate 1.544Mbps on a 100–kHz line?

$$C = bandwidth \times \log_2(1 + S/N) = 100k \times \log_2(1 + S/N) = 1.544 \times 10^6$$
$$\text{解得}S/N = 2^{15.44} - 1 \approx 46dB$$

7. It is desired to send a sequence of computer screen images over an optical fiber. The screen is 1920 × 1200 pixels, each pixel being 24 bits. There are 50 screen images per second. How much bandwidth is needed?

$$bandwidth = 1920 \times 1200 \times 24 \times 50 = 2.765 Gbps$$

8. Is the Nyquist theorem true for high–quality single–mode optical fiber or only for copper wire?

在实际应用中，奈奎斯特用于计算在模拟信道上承载数字数据的最大数据率。因此，奈奎斯特定理适用于任何传输媒体，包括 high–quality single–mode optical fiber

21. A modem constellation diagram similar to Fig. 2–23 has data points at (0, 1) and (0, 2). Does the modem use phase modulation or amplitude modulation?

数据点相位一直是 0，使用了不同的振幅，因此是振幅调制 amplitude modulation

24. An ADSL system using DMT allocates 3/4 of the available data channels to the down–stream link. It uses QAM–64 modulation on each channel. What is the capacity of the downstream link?

ADSL 有 256 个 channel：其中248个channel是用于User data

根据课上ppt 每个 channel 为 4000 baud

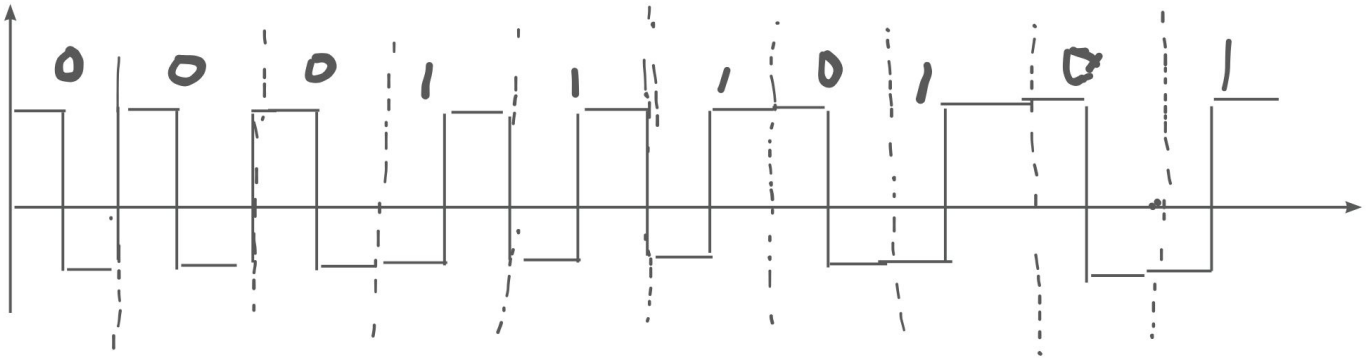
$$则Capacity\ of\ the\ downstream\ link = 248 \times \frac{3}{4} \times 4000 \times \log_2 64 = 4.464 Mbps.$$

25. Ten signals, each requiring 4000 Hz, are multiplexed onto a single channel using FDM. What is the minimum bandwidth required for the multiplexed channel? Assume that the guard bands are 400 Hz wide.

十个信号复用在一起的时候，每个信号之间都要有保护带,也就是一共九个保护带

$$the\ minimum\ bandwidth = 4000 \times 10 + 400 \times 9 = 43600 Hz$$

4–14. Sketch the Manchester encoding on a classic Ethernet for the bit stream 0001110101.



26. Why has the PCM sampling time been set at 125 μsec?

信道的带宽是 4000Hz 根据奈奎斯特定理 2B 是每秒采样8000次 算一下 1/8000 其实就能得出 125 μsec

28. Compare the maximum data rate of a noiseless 4–kHz channel using

(a) Analog encoding (e.g., QPSK) with 2 bits per sample.

(b) The T1 PCM system.

a) 最大数据率== 2 * 4000 *2=16kbps

b) 最大数据率== 2 * 4000 *7=56kbps

37. Suppose that ***x*** bits of user data are to be transmitted over a ***k–hop*** path in a packet switched network as a series of packets, each containing ***p*** data bits and ***h*** header bits, with $x >> p + h$. The bit rate of the lines is ***b*** bps and the propagation delay is negligible. What value of ***p*** minimizes the total delay?

$$delay == x/p \times (p+h)/b + (k-1) \times (p+h)/b$$

对p求导 令导数为零

$$p = \sqrt{hx/k-1}$$