Chapter 2

1. 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?

根据香农公式 $S/N_{dB} = 10\log_{10} S/N$ $S/N = 100$

最大数据速率 $= B \times \log_2(1+S/N) = 19.997\text{kbps}$

根据奈奎斯公式：最大速率为 $2 \times B \times \log_2 V = 6\text{kbps}$

2. What signal-to-noise ratio is needed to put a T1 carrier on a 50-kHz line?

$H \times \log_2(1+S/N) = 1.544 \times 10^6$

$S/N \approx 46\text{dB}$

3. Ten signals, each requiring 4000 Hz, are multiplexed on to a signal channel using FDM. How much minimum bandwidth is required for the multiplexed channel? Assume that the guard bands are 400 Hz wide.

$4000 \times 10 + 400 \times 9 = 43600\text{Hz}$

Chapter 3

1. A bit string, 0111101111101111110, needs to be transmitted at the data link layer. What is the string actually transmitted after bit stuffing?

01111011111001111110

2. What is the remainder obtained by dividing x^7 + x^5+1 by the generator polynomial x^3 +1 ? (注：x^7 表示 x 的 7 次方，其它表述方式相同)

将 $M(x) = x^7 + x^5 + 1$ 表示为2进制为 10100001

r=3. 将 M(x) 左移3位得 10100001000

R(x): 10100001000 % G(x) = 111

3 Data link protocols almost always put the CRC in a trailer rather than in a header. Why?

串行通信接受完帧后可以直接看校验位，节省存储，加速；否则要额外存储CRC，效率降低

4. Frames of 1000 bits are sent over a 1-Mbps channel using a geostationary satellite whose propagation time from the earth is 270 msec. Acknowledgements are always piggybacked onto data frames. The headers are very short. Three-bit sequence numbers are used. What is the maximum achievable channel utilization for

a) (a) Stop-and-wait.

b) (b) Protocol 5

c) (c) Protocol 6

$t = 1 + 270 + 1 + 270 = 542$

a) $k = 1$ $1/542 = 0.18\%$

b) $k = 7$ $7/542 = 1.29\%$

c) $k = 4$ $4/542 = 0.74\%$

5. What is the minimum overhead to send an IP packet using PPP? Count only the overhead introduced by PPP itself, not the IP header overhead.

每帧 2个标志字节，1个协议字节，2个校验字节
共 5个字节

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