

KFUPM-EE DEPT.
EE418- Satellite Communications
Dr. Ali Muqaibel

Assignment # 4

Due:

Modulation and Multiplexing in Satellite Communications

1. A C-band satellite link sends a single NTSC-TV signal through a 36 MHz transponder on a C-band GEO satellite. The NTSC video signal is modulated onto the carrier using wideband frequency modulation, and the bandwidth of the transmitted RF signal is 32 MHz. The baseband bandwidth of the TV signal is 4.2 MHz.
 - a. Calculate the peak frequency deviation of the FM carrier using Carson's rule.
 - b. Calculate the unweighted FM improvement factor for the video signal.
 - c. The overall C/N in an earth station receiving the FM-TV transmission is 17 dB. What is the unweighted video S/N ratio at baseband?
 - d. De-emphasis and weighting factors improve the S/N of the baseband signal by a subjective factor of 17 dB. What is the weighted S/N of the baseband video signal?

2. A Ku band satellite uplink has a carrier frequency of 14.125 GHz and carries a symbol stream at $R_s = 16$ Msps. The transmitter and receiver have ideal RRC filters with $\alpha = 0.25$. What is bandwidth occupied by RF signal, and what is the frequency range of the transmitted RF signal?

3. A satellite data transmission system transmits data from two T1 carriers as a single 3.088 Mbps bit stream using QPSK. The symbol rate on the link is 1.544 Msps. The satellite link uses ideal RRC filters with $\alpha = 0.25$. At the receiving terminal the clear air value of overall $(C/N)_o$ is 16.0 dB and the implementation margin of the QPSK demodulator is 1 dB.
 - a. What is the bandwidth occupied by this signal, and the noise bandwidth of the receiver for this signal?
 - b. Find the BER at the receiver output and the average time between errors.
 - c. Rain affects the downlink from the satellite and the overall C/N ratio in the receiver falls by 6.0 dB to 10.0 dB. What is the bit error rate now?

4.
 - a. A 36 MHz bandwidth transponder is used to carry digital signals. A 20 MHz bandwidth in the transponder is occupied by a QPSK signal generated by a transmitter with ideal Nyquist filters with parameter $\alpha = 0.25$. What is the symbol rate of the QPSK signal in Msps? What is the bit rate of the QPSK signal?

 - b. Under clear air conditions, the overall $(C/N)_o$ ratio in the earth station receiver is 18.0 dB. If the QPSK demodulator has an implementation margin of 1.5 dB, what is the Bit Error Rate of the baseband digital signal in clear air conditions? How often does a bit error occur. (Give your answer in days, hours, minutes, or seconds, as appropriate.)

 - c. Under rain conditions, the overall $(C/N)_o$ ratio of the QPSK signal in part (a) above falls to 14.3 dB at a receiving station. What Bit Error Rate would you expect in the recovered bit stream? How often does a bit error occur?