The University of New Mexico

School of Engineering

Electrical and Computer Engineering Department

ECE 535 Satellite Communications

Student Name: Alex Hostick

Student SN: 2O1

Module # 10-1: 14.9, 14.14, 14.16, 14.17, 14.18, 14.38, 14.48

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Prof. Tarief Elshafiey

14.9 Asatellite transponder has a saturation EIRP of 25 dBW and a bandwidth of 27 MHz. The transponder resources are shared equally by a number of FDMA carriers, each of bandwidth 3 MHz, and each requiring a minimum EIRP of 12 dBW. If 7 dB output backoff is required, determine the number of carriers that can be accommodated.

$$K = \frac{B_{TR} - [BO]}{B} = \frac{27 - 7}{3} = 6.67, or\ 6\ carriers\ (rounded\ down)$$

14.14 Determine how many carriers can access an 80-MHz transponder in the FDMA mode, given that each carrier requires a bandwidth of 6 MHz, allowing for 6.5-dB output backoff. Compare this number with the number of carriers possible without backoff.

$$B_{TR} = 80MHz, or\ 79.03dBHz; B = 6MHz, or\ 67.78dBHz; BO = 6.5dB$$

With back off…

$$[K] = -6.5 + 79.03 - 67.78 = 4.75dB$$

$$K = 10^{4.75/10} = 2.98, or\ 2\ carriers\ (rounded\ down)$$

Without back off…

$$K = \frac{80MHz}{6MHz} = 13.33, or\ 13\ carriers\ (rounded\ down)$$

14.16 Describe the general operating principles of a TDMA network. Show how the transmission bit rate is related to the input bit rate.

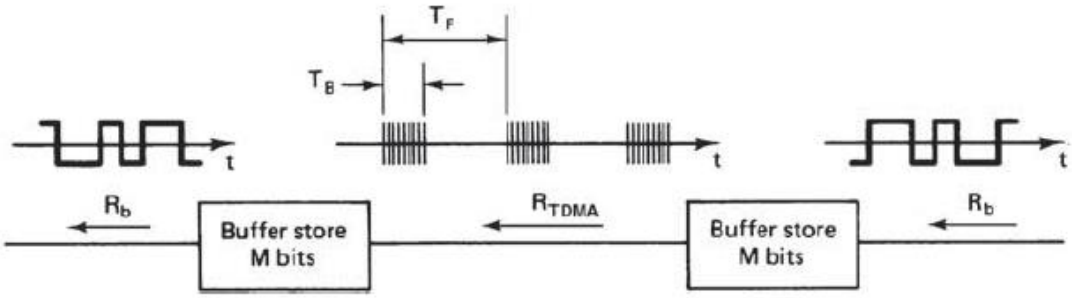
With TDMA, only one carrier uses the transponder at any one time, and therefore, intermodulation products, which result from the nonlinear amplification of multiple carriers, are absent. Because the signal information is transmitted in bursts, TDMA is only suited to digital signals. Digital data can be assembled into burst format for transmission and reassembled from the received bursts using digital buffer memories.

The transmission bit rate (T_B) is related to the input bit rate (R_b) with the M bits transmitted per time frame (T_F):

$$M = R_b T_F$$

M bits are transmitted as bursts in the next frame in burst time T_B, ultimately to adhere to the TDMA rate (R_{TDMA})

$$R_{TDMA} = R_b \frac{T_F}{T_B}$$



14.17 Explain the need for a reference burst in a TDMA system.

A TDMA reference burst is using the one station assigned as a synchronization reference bursts to which others can synchronize. Due to the time dependency of TDMA, all other stations must keep their frames in order from one reference burst to the next. A reference burst is required at the beginning of each frame to provide timing information for the acquisition and synchronization of bursts. In some systems, message preambles and reference bursts are the same.

14.38 (a) Describe the general features of an on-board signal processing transponder that would allow a network to operate with FDMA uplinks and a TDMA downlink. (b) In such a network, the overall BER must not exceed 10^{-5}. Calculate the maximum permissible BER of each link, assuming that each link contributes equally to the overall value.

(a) On-Board Signal processing

With a signal processing transponder, FDMA uplink signals are converted to the TDM format for retransmission on the downlink. The signal processing transponder "decouples" the uplink from the downlink, allowing the performance of each link to be optimized independently for the other.

(b) Maximum permissible BER of each link for a system BER < 10^{-5}

For overall BER to remain less than 10^{-5}:

$$10^{-5} = N \times BER\ per\ link$$

If one uplink and one downlink required, N=2

$$BER\ per\ link = \frac{10^{-5}}{2} = 5x10^{-6} maximum\ per\ link$$

14.48 Explain the principle behind spectrum spreading and despreading and how this is used to minimize interference in a CDMA system.

The dispreading function is a function, after acquisition and tracking have been accomplished, to restore the spectrum of wanted signal to what it was before the spreading operation in the transmitter. This is also how the spread-spectrum technique reduces interference.

In a CDMA system, the spectrum is restored and the interfering channel is multiplied by the code signal (c(t)) resulting in the interfering channel to be spread.