The University of New Mexico

School of Engineering

Electrical and Computer Engineering Department

ECE 535 Satellite Communications

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Module # 12-3: 12.27, 12.28, 12.29, 12.31, 12.33, 12.35

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12.27 Determine the carrier-to-noise density ratio at the satellite input for an uplink, which has the following parameters: operating frequency 6 GHz, saturation flux density -95 dBW/m^2, input BO 11 dB, satellite [G/T] -7 dBK^{-1}, [RFL] 0.5 dB. (Tabulate the link budget values as shown in the text).

$$f = 6GHz, \Psi_S = -95dBW/m^2; [BO] = 11dB; [G/K] = -7dBK^{-1}; [RFL] = 0.5dB$$

$A_0 = -(21.45 + 20\log(6)) = -37.01dB$

$[C/N] = [\Psi_M] + [A_0] + [RFL] + [BO] + \left[\frac{G}{K}\right] + [k]$

$[C/N] = [-95] + [-37.01] - [0.5] - [11] + [-7] + [228.6]$ = 78.1dB

12.28 For an uplink the required [C/N] ratio is 20 dB. The operating frequency is 30 GHz, and the bandwidth is 72 MHz. The satellite [G/T] is 14.5 dBK^{-1}. Assuming operation with 11 dB input BO, calculate the saturation flux density. [RFL] are 1 dB.

$$\left[\frac{C}{N}\right] = 20dB; f = 30GHz, BW = 72MHz, \left[\frac{G}{T}\right] = 14.5dbK^{-1}; [BO] = 11dB; [RFL] = 1dB$$

(a) Calculate flux density [$\boldsymbol{\Psi_S}$]

$$A_0 = -(21.45 + 20\log(30)) = -51dB$$

$$[B] = 10\log(72MHz) = 78.6dB$$

$$\left[\frac{C}{N_0}\right] = \left[\frac{C}{N}\right] + [B_N]$$

$$[\Psi_S] = \left[\frac{C}{N}\right] + [B_N] - [A_0] + [B_0]_i - \left[\frac{G}{T}\right]_U + [R] + [RFL]$$

$$[\Psi_S] = 20 + 78.6 + (-51) + 11 - 14.5 - 228.6 + 1 = -81.5dBW/m^2$$

12.29 For the uplink in Prob. 12.28, the total losses amount to 218 dB. Calculate the earth station [EIRP] required.

Losses = 218dB

$[EIRP]_U = [\Psi_S] + [A_0] + [LOSSES\} - [RFL]$

$[EIRP]_U = [-81.5] + [-51] + [218\} - [1] = 84.5dBW$

$[EIRP]_U = [EIRP_S\}_U - [BO]_i$

$[EIRP]_U = 84.5 - 11 = 73.5dBW$

12.31 The following parameters apply to a satellite downlink: saturation [EIRP] 22.5 dBW, free-space loss 195 dB, other losses and margins 1.5 dB, earth station [G/T] 37.5 dB/K. Calculate the [C/N0] at the earth station. Assuming an output BO of 6 dB is applied, what is the new value of [C/N0]?

Quantity	Decilogs
[EIRP]	22.5
[FSL]	-195
[LOSSES]	-1.5
[G/T]	37.5
[k]	228.6

(a) C/N0 at earth station

$[CN0] = [22.5] + [-195\} + [-1.5] + [37.5] + [228.6] = 92.1dBHz$

(b) C/N0 with BO = 6dB added

$[CN0] = [92.1] - [6dB] = \ 86.1dBHz$

12.33 The [C/N] values for a satellite circuit are uplink 25 dB, downlink 15 dB. Calculate the overall [C/N] value.

$$\frac{N}{C} = 10^{-2.5} + 10^{-1.5} = 0.0347856$$

$$\left[\frac{C}{N_0}\right] = -10 * \log(0.0347856) = 14.6 dBHz$$

12.35 A satellite circuit has the following parameters:

	Uplink, decilogs	Downlink, decilogs
[EIRP]	54	34
[G/T]	0	17
[FSL]	200	198
[RFL]	2	2
[AA]	0.5	0.5
[AML]	0.5	0.5

Calculate the overall [C/N_0] value.

[LOSSES] = [FSL] + [RFL] + [AA] + [AML]

[GAIN] = [EIRP] + [G/T] + [k]

<u>Uplink</u>

[LOSSES] = 200 + 2 + 0.5 + 0.5 = 203

[GAINS] = 54 + 0 + 282.6 = 282.6

Uplink = [EIRP] – [LOSSES] = 282.6 – 203 = 79.6

<u>Downlink</u>

[LOSSES] = 198 + 2 + 0.5 + 0.5 = 201

[GAINS] = 34 + 17 + 228.6 = 279.6

Downlink = [EIRP] – [LOSSES] = 279.6 – 201 = 78.6

$N/C = 10^{-7.96} + 10^{-7.86} = 1.11028x10^{-8}$

$C/N = -10 * \log(1.11028x10^{-8}) = 76.1dBHz$