PROPAGATION TRANSMISSION LOSSES AND SYSTEM NOISE

3.7 Transmisssion losses

The [EIRP] is the power input to one end of the transmission link, and the problem is to find the power received at the other end.

Losses will occur along the way, some of which are constant. Other losses can only be estimated from statistical data, and some of these are dependent on weather conditions, especially on rainfall.

The first step in the calculations is to determine the losses for clear weather, or clear-sky, conditions. These calculations take into account the losses, including those calculated on a statistical basis, which do not vary significantly with time. Losses which are weather-related, and other losses which fluctuate with time, are then allowed for by introducing appropriate fade margins into the transmission equation.

3.8 The Link-Power Budget Estimation

Losses for clear sky conditions are

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

The decibel equation for the received power is

$$[P_R] = [EIRP] + [G_R] - [LOSSES]$$

where

[PR] = received power, dBW

[EIRP] = equivalent isotropic radiated power, dBW

[FSL] = free-space spreading loss, dB
[RFL] = receiver feeder loss, dB
[AML] = antenna misalignment loss, dB
[AA] = atmospheric absorption loss, dB
[PL] = polarization mismatch loss, dB

3.9 System Noise

The major source of electrical noise in equipment is from the random thermal motion of electrons in various resistive and active devices in the receiver.

Thermal noise is also generated in the lossy components of antennas, and thermal-like noise is picked up by the antennas as radiation.

The available noise power from a thermal noise source is given by

$$P_N = kT_N B_N$$

Where

T_N = equivalent noise temperature (K)

B_N = equivalent noise bandwidth (Hz)

k = 1.38×10^{-23} (Boltzmann's constant)

For thermal noise, noise power per unit bandwidth, N0, is constant (a.k.a noise energy)

$$N_0 = \frac{P_N}{B_N} = kT_N \ joules$$

In addition to thermal noise, intermodulation distortion in high-power amplifiers result in signal products which appear as noise, that is intermodulation noise.

3.10 Carrier-to-Noise Ratio

A measure of the performance of a satellite link is the ratio of carrier power to noise power at the receiver input.

Conventionally, the ratio is denoted by C/ N (or CNR), which is equivalent to PR/PN.
In terms of decibels,

$$\left[\frac{C}{N}\right] = [P_R] - [P_N]$$

Equations (12.17) and (12.18) may be used for [PR] and [PN], resulting in

$$\left[\frac{C}{N}\right] = [EIRP] + [G_R] - [LOSSES] - [k] - [T_S] - [B_N]$$

The G/ T ratio is a key parameter in specifying the receiving system performance

$$\left[\frac{G}{T}\right] = [G_R] - [T_S]\, dBK^{-1}$$

Since $P_N = kT_N B_N = N_o B_N$, then

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

$$= \left[\frac{C}{N_o}\right] - [B_N]$$

therefore

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

The final expresion is

$$\left[\frac{C}{N_o}\right] = [EIRP] + \left[\frac{G}{T}\right] - [LOSSES] - [k]\ dBHz \quad \text{---(1)}$$

Source : http://elearningatria.files.wordpress.com/2013/10/ece-vi-satellite-communications-10ec662-notes.pdf