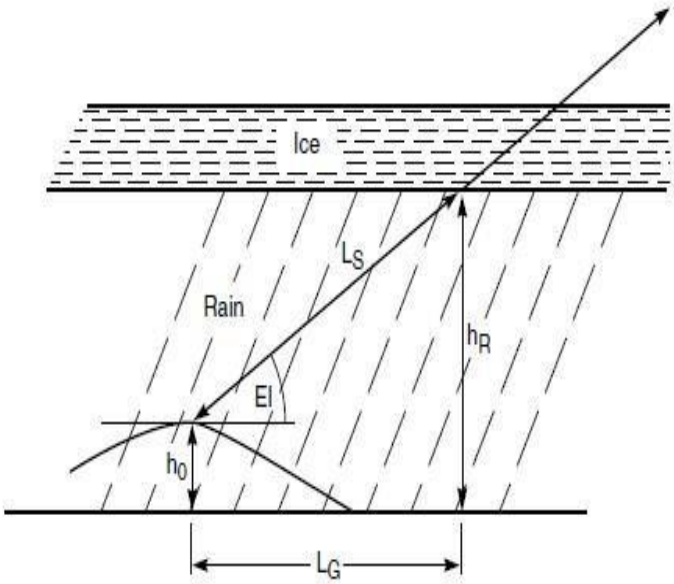
3.3 Rain Induced Attenuation: Rain attenuation is a function of *rain rate.* The rain rate is measured in millimeters per hour. The total attenuation is given as $A=\alpha L$ Db *α-Specfic attenuation L-Effective path length* of the signal through the rain The geometric, or slant, path length is shown as L_S. This depends on the antenna angle of elevation and the *rain height* h_R, which is the height at which freezing occurs.



$$L_S = \frac{h_R - h_O}{\sin El}$$

- The effective path length is given in terms of the slant length by $L = L_S r_p$ where r_p is a *reduction factor* which is a function of the percentage time p and L_G, the horizontal projection of L_S. $L_G = L_S \cos El$ With all these factors together into one equation, the rain attenuation in decibels is given by,

$$A_p = aR_p{}^b L_S r_p \text{ dB}$$

Link budget calculations

Equivalent Isotropic Radiated Power:

A key parameter in link budget calculations is the equivalent isotropic radiated power (EIRP). An isotropic radiator with an input power equal to GP_S would produce the same flux density. Hence this product is referred to as the equivalent isotropic radiated power. EIRP = GP_S,

G= Gain and P_S = Power Supplied.

Free Space Loss

In the loss calculations, the power loss resulting from the spreading of the signal in space must be determined. The power flux density at the receiving antenna is given as

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$$\Psi_M = \frac{\text{EIRP}}{4\pi r^2}$$

The power delivered to a matched receiver is this power flux d
ty multiplied by the effective aperture of the receiving antenna, g
by Eq. The received power is therefore

$$P_R = \Psi_M A_{\text{eff}}$$

$$= \frac{\text{EIRP}}{4\pi r^2} \frac{\lambda^2 G_R}{}$$

$$= (\text{EIRP})(G_R)\left(\frac{\lambda}{4\pi r}\right)^2$$

$$[P_R] = [\text{EIRP}] + [G_R] - 10\log\left(\frac{4\pi r}{\lambda}\right)^2$$

$$[\text{FSL}] = 10\log\left(\frac{4\pi r}{\lambda}\right)^2$$

$$[P_R] = [\text{EIRP}] + [G_R] - [\text{FSL}]$$

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3.8 Interference

- With many telecommunications services using radio transmissions, interference between services can arise in a number of ways.

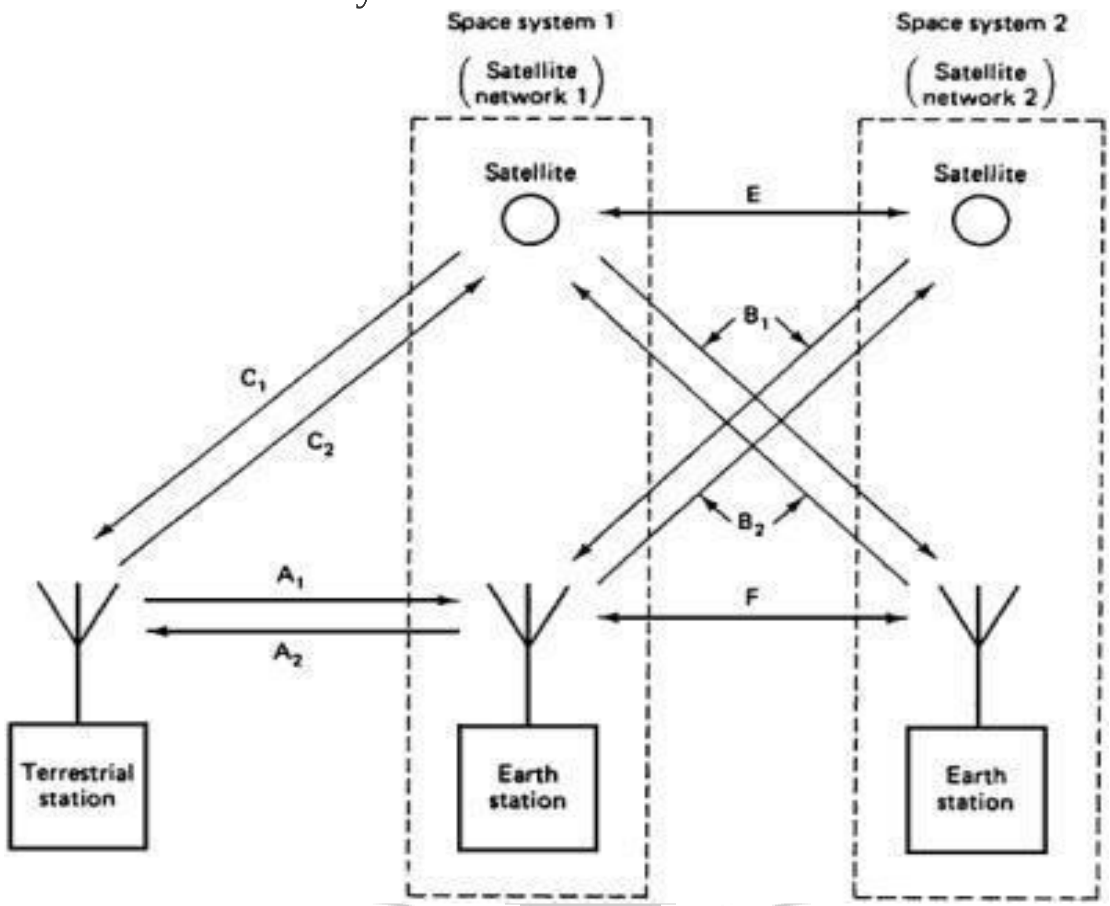

Fig (a)

Possible interference modes between satellite circuits and a terrestrial station Fig. (a) are classified by the International Telecommunications Union (ITU, 1985) as follows: A1: terrestrial station transmissions, possibly causing interference to reception by an earth station A2: earth station transmissions, possibly causing interference to reception by a terrestrial station B1: space station transmission of one space system, possibly causing interference to reception by an earth station of another space system B2: earth station transmissions of one space system, possibly causing interference to reception by a space station of another space system C1: space station transmission, possibly causing interference to reception by a terrestrial station C2: terrestrial station transmission, possibly causing interference to reception by a space station E: space station transmission of one space system, possibly causing interference to reception by a space station of another space system F: earth station transmission of one space system, possibly causing interference to reception by an earth

Combined [C/I] due to interference on both uplink and downlink

Interference may be considered as a form of noise, and assuming that the interference sources are statistically independent, the interference powers may be added directly to give the total interference at receiver B. The uplink and the downlink ratios are combined in exactly the same manner described for noise, resulting in Here, power ratios must be used, not decibels, and the subscript "ant" denotes the combined ratio at the output of station B receiving antenna station of another space system