Fout = $m.\frac{v^2}{r}$, Fin = $m . \frac{\mu}{r^2}$

centripetal acc = $\frac{\mu}{r^2}$, centrifugal acc = $\frac{v^2}{r}$

*r = $\frac{\mu}{v^2}$, r = re + h

v = $\frac{d}{t} = \frac{2\pi r}{t}$

t= $\frac{2\pi (h+re)^{3/2}}{\mu^{0.5}}$, t = $\frac{2\pi\mu}{v^3}$

*Fspl = $\frac{Pt}{Pr}$

Fspl = 20log(Dkm)+20log(FMhz)+32.45

Pr = flux density * Aeff

Flux density = $\frac{Pt.Gt}{4\pi r^2}$, Aeff = $\frac{Gr\,\lambda^2}{4\pi}$

d (slant range) = rs $\left[1 + \left(\frac{re}{rs}\right)^2 - 2\left(\frac{re}{rs}\right)\cos(\gamma)\right]^{0.5}$

Cos(γ) (center angle) = cos(Le) cos(Ls) cos(ls-le) + sin(Le)sin(Ls)

EIRP = Pt*Gt = w

EIRP = Pt+Gt =db

α (intermediate angle) = $\tan^{-1}\left(\frac{\tan(ls-le)}{\sin(Le)}\right)$

$$\frac{rs}{\sin(\psi)} = \frac{d}{\sin(\gamma)}$$

El = ψ - 90

Cos(El) = $\frac{\sin(\gamma)}{\left[1+\left(\frac{re}{rs}\right)^2-2\left(\frac{re}{rs}\right)\cos(\gamma)\right]^{0.5}}$

El = tan-¹ [(6.6107345 – cos γ)/sin γ] – γ

*G (Antenna gain) = $\frac{4\pi}{\lambda^2} * Aeff$

Aeff = η.$\frac{\pi.D^2}{4}$ D (Antenna diameter)

η (Aperture efficiency)

G = 10 log (110. η. D^2"m". f^2"GHz") = dbw

the maximum central angular

$\gamma \leq 81.3°$ → $\gamma \leq \cos^{-1}\left(\frac{re}{rs}\right)$

N (Noise Power) = KTB = w

N = -228.6 + 10log (T) + 10log (B) = dbw

K (Boltzmann's constant) = 1.38*10^-23 j/k

B (Bandwidth) = Hz , T (noise temperature) = Kelvin

No (noise power density) = KT

Case 1: Earth station in North Hemisphere with

(a) Satellite to the SE of the earth station Az = 180 – α

(b) Satellite to the SW of the earth station Az = 180 + α

Case 2: Earth station in South Hemisphere with

(c) Satellite to the SE of the earth station Az =α

(d) Satellite to the SW of the earth station Az 360 - α

NF (Noise Figure) = $\frac{SNRin}{SNRout}$

Antenna thermal noise = (1 - η) To

Ta (Antenna noise) = Ts +(1-η)To

To (ambient temp) = 290 k

N (Cluster size) =$i^2 + j^2 + ij$

D(frequency reuse distence) = R $\sqrt{3N}$

q(reuse ratio) = $\frac{D}{R} = \sqrt{3N}$

Td (convert noise figure to noise temp) = To(NF-1)

Ts (system noise temp) = Tin + Trf + $\frac{Tm}{Grf} + \frac{Tif}{Grf.Gm}$ [k]

(absolute temp)

$C/No = Pr - No$

G/T (Figure of merit) = $\frac{Gr}{Ts}$ [db/k]

C/N = (signal power to noise power ratio) = $\frac{Pr}{Pn}$ =

$$C/N = \frac{Pt\,Gt\,Gr}{K\,Ts\,B} . \left[\frac{\lambda}{4\pi d}\right]^2 , \quad C/No = \frac{Pt\,Gt\,Gr}{K\,Ts} . \left[\frac{\lambda}{4\pi d}\right]^2$$