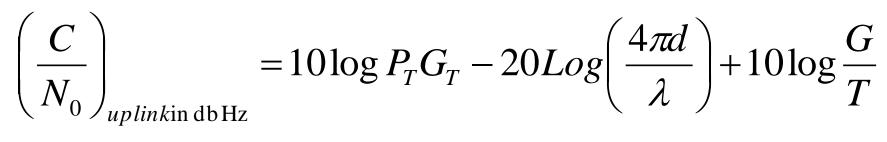
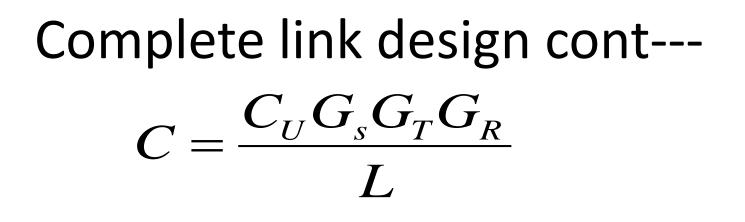
### **Uplink Design**



$$-10LogL_{A} - 10LogK - BO_{i}$$

# COMPLETE LINK DESIGN

- TWO EARTH STATION AND SATELLITE
- UP LINK AND DOWN LINK
- (UPLINK, SATELLITE TRANSPONDER, DOWN LINK
- UPLINK (C/No)u AT TRANSPONDER INPUT
- DOWNLINK (C/No)d



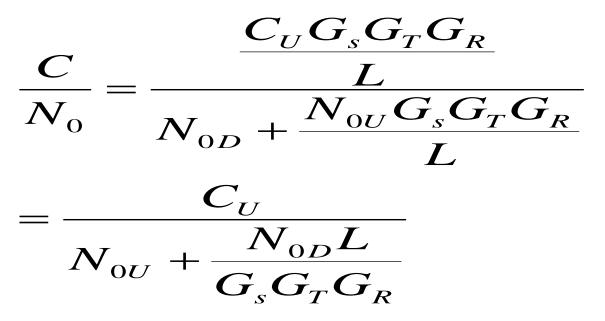
- C Carrier Signal At Receiving Earth Station CU - SIGNAL POWER AT THE SATELLITE TRANSPONDER INPUT
- Gs SATELLITE TRANSPONDER GAIN
- GT- GAIN OF THE SATELLITE TRANSMITTING ANTENNA
- GR GAIN OF THE RECEIVING ANTENNA
- L LOSSES ON THE DOWN LINK

# NOISE POWER SPECTRAL DENSITY AT THE INPUT OF THE RECEIVING ANTENNA

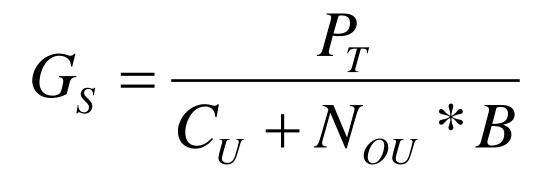
$$N_0 = N_{0D} + \frac{N_{0U}G_sG_TG_R}{L}$$

N° IS NOISE POWER SPECTRAL DENSITY AT THE INPUT OF THE RECEIVING STATION

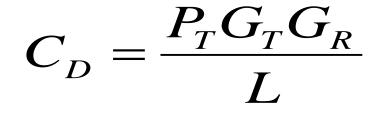
Nou IS NOISE POWER SPECTRAL DENSITY AT THE TRANSPONDER INPUT



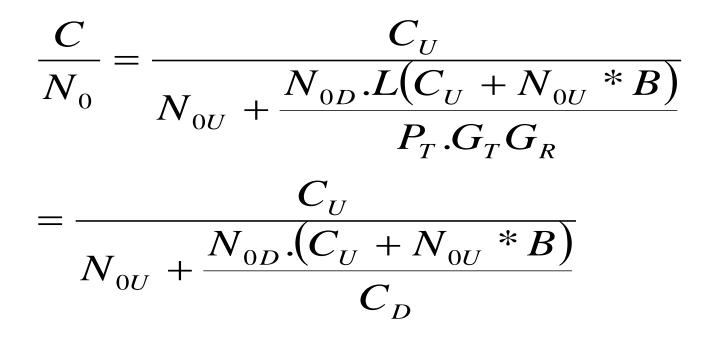
# TRANSPONDER HAS A BAND WIDTH B AND RADIATES A CONSTANT POWER $P_{\text{T}}$ and its gain $G_{\text{S}}$



#### FOR DOWN LINK SIGNAL POWER CD



THUS C/No



$$\frac{C}{N_0} = \frac{\frac{C_U * C_D}{N_{0U} * N_{0D}}}{\frac{N_{0U} * C_D + N_{0D} \cdot (C_U + N_{0U} * B)}{N_{0U} * N_{0D}}}$$
$$= \frac{\left(\frac{C}{N_0}\right)_u * \left(\frac{C}{N_0}\right)_D}{\left(\frac{C}{N_0}\right)_u + \left(\frac{C}{N_0}\right)_D} + B}$$
$$\left(\frac{C}{N_0}\right)_T^{-1} = \left(\frac{C}{N_0}\right)_u^{-1} + \left(\frac{C}{N_0}\right)_D^{-1} \rightarrow B \le \left(\frac{C}{N_0}\right)_u & \left(\frac{C}{N_0}\right)_D$$

# Complete link design

- Effect of interfering signals
- *I* is noise power involved with the interfering signals under the band width of the desired carrier than , the net C/N ratio (for uplink)

$$\left(\frac{C}{N}\right)_{netuplink} = \left[\left(\frac{C}{N}\right)_{U}^{-1} + \left(\frac{C}{I}\right)_{U}^{-1}\right]$$

$$\begin{split} \left(\frac{C}{N}\right)_{net \, downlink} &= \left[\left(\frac{C}{N}\right)_{D}^{-1} + \left(\frac{C}{I}\right)_{D}^{-1}\right]^{-1} \\ \left(\frac{C}{N}\right)_{net \, downlink} &= \left[\left(\frac{C}{N}\right)_{Net \, uplink} + \left(\frac{C}{N}\right)_{net \, downlink}\right]^{-1} \\ &= \left[\left(\frac{C}{N}\right)_{u}^{-1} + \left(\frac{C}{I}\right)_{u}^{-1} + \left(\frac{C}{N}\right)_{D}^{-1} + \left(\frac{C}{I}\right)_{D}^{-1}\right]^{-1} \\ \left[\left(\frac{C}{N}\right)^{-1} + \left(\frac{C}{I}\right)^{-1}\right]^{-1} \\ \left(\frac{C}{I}\right)^{-1} &= \left(\frac{C}{I}\right)_{u}^{-1} + \left(\frac{C}{I}\right)_{D}^{-1} \end{split}$$

# Complete link design contt---

- C/N CARRIER TO NOISE OF OVERALL LINK
- C/I CARRIER TO INTERFACE RATIO OF OVERALL
  LINK
- C/I > C/N SATELLITE LINK IS NOISE DOMINANT
- C/I< C/N SATELLITE IS CALLED INTERFERANCE DOMINENT
- FOR A TYPICAL FM DEMODULATOR S/N AFTER
   DEMODULATOR
- (S/N)<sub>OUTPUT</sub> = (C/N)<sub>in</sub> + FM <sub>IMPROVEMENT</sub>

#### Earth station parameter

$$\frac{C}{N_0} = \frac{P_T G_T G_R}{KT_S} \left(\frac{\lambda}{4\pi d}\right)^2 \frac{1}{L_A}$$

d is the range between transmitting and receiving antenna

$$G = \eta \left(\frac{4\pi D}{\lambda}\right)^2$$
$$G = \frac{\eta 4\pi^2 70^2}{\theta_{3dB}^2}$$

#### Contd----

- η antenna efficiency
- (θ3db )sat satellite antenna beam width
- DES is earth station diameter

$$G = \eta \left(\frac{4\pi D}{\lambda}\right)^2$$
$$G = \frac{\eta 4\pi^2 70^2}{\theta_{3dB}^2}$$

#### Earth station parameter

$$\frac{C}{N_0} = \frac{P_T}{L_A N_0} \eta_T \eta_R - \frac{\pi^2 70^2 D_{ES}^2}{d^2 (\theta_{3db})_{sat}^2}$$

#### FOR FIXED EARTH STATION

$$\frac{C}{N_0} = \frac{P_T}{L_A N_0} \eta_T \eta_R \frac{\pi^2 C^2 70^2}{(4d)^2 (\theta_{3db})_{sat}^2 (\theta_{3db})_{ES}^2 \cdot f^2}$$

$$\frac{C}{N_0} = \frac{P_T}{L_A N_0} \eta_T \eta_R \left(\frac{\pi D_{sat} D_{ES}}{4dC}\right)^2 f^2$$