EXPERIMENT - 11

LINK BUDGET

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AIM: To discuss the link budget design of cellular communication and satellite communication.

THEORY:

A link budget is an accounting of all of the power gains and losses that a communication signal experiences in a telecommunication system; from a transmitter, through a communication medium such as radio waves, cable, waveguide, or optical fiber, to the receiver.

Link power budget formula for received power:

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

SATELLITE COMMUNICATION & CELLULAR COMMUNICATION:

Satellites communicate by using radio waves to send signals to the antennas on the Earth. The antennas then capture those signals and process the information coming from those signals whereas, Cellular communication is a

form of communication technology that enables the use of mobile phones. A mobile phone is a bidirectional radio that enables simultaneous transmission and reception. Cellular communication is based on the geographic division of the communication coverage area into cells, and within cells.

LINK BUDGET PARAMETERS FOR SATELLITE & CELLULAR COMMUNICATION:

- Transmission Losses

The difference between the power sent at one end and received at the receiving station is known as Transmission losses. The losses can be categorized into 2 types: Constant losses & Variable losses.
Loss equation is:
Losses=FSL+RFL+AML+AA+PL
Where,
RFL stands for received feeder loss and units are db.
PL stands for polarization mismatch loss.

- Transmit Power

The transmit power of an access point is proportional to its effective range. The higher the transmit power, farther a signal travel and more obstruction it can effectively penetrate.

● Received Power

Received power(dBm)=Transmitted power (dBm)+Gains(dB)–Losses(dB).

● Transmit Antenna Gain

The gain of practical antenna is defined as the ratio of maximum power flux density of practical antenna and power flux density of isotropic antenna.

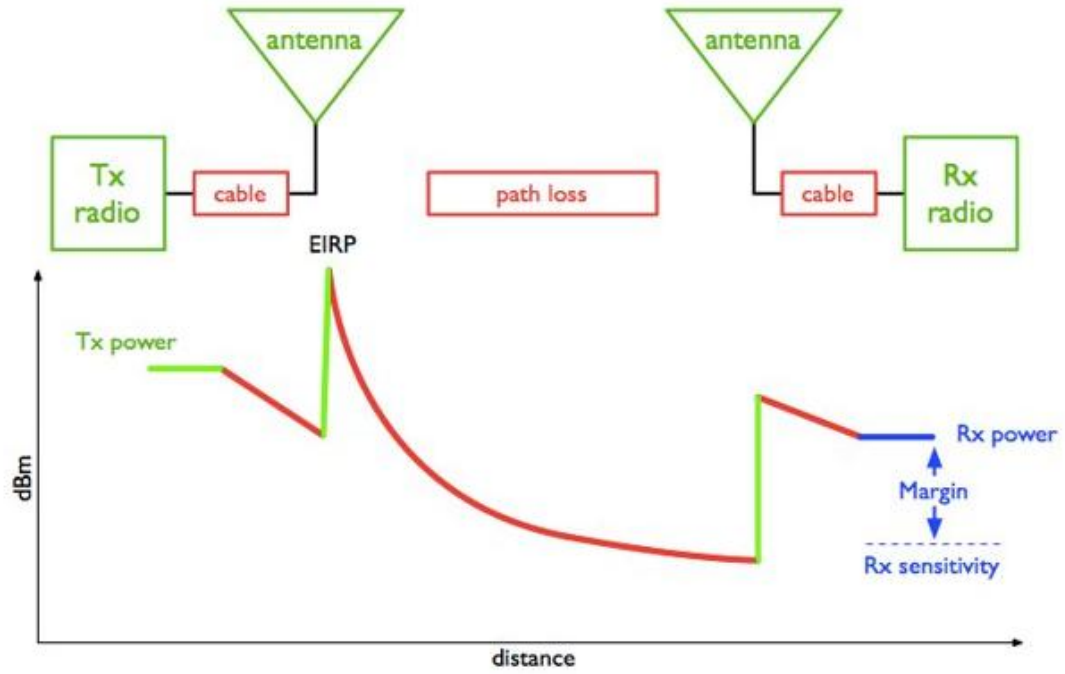
● Free Space Loss

$$\frac{P_r}{P_t} = D_t D_r \left(\frac{\lambda}{4\pi d}\right)^2$$

● Link Margin

The difference between the minimum received signal level and the actual received power is called link margin.

POWER IN CELLULAR



Example of a typical link budget:

PARAMETERS	DOWNLINK	UPLINK
SIGNAL BANDWIDTH	6GHz	3GHz
TRANSMIT POWER	20dBm	20dBm
TRANSCEIVER ANTENNA GAIN	50dBi	50dBi
ATMOSPHERIC ATTENUATION	1dB/km	1dB/km
MAXIMUM PATH LOSS	145.1dB	155.5Db
TOTAL NOISE+MARGIN	-100.8dBm	-102.7dBm
ANTENNA GAIN	2dBi	18dBi
SENSITIVITY	-45dBm	-50dBm
EIRP	44dBm	26dBm
RECEIVED POWER	-35.9dBm	-35.9dBm
FREE SPACE LOSS	131.7dB/km	131.7dB/km
LINK MARGIN	9.1dB	14.1Db

CONCLUSION:

From the above case study I learnt about the link budget system in cellular and satellite communication. Thus, link budget is required so that we can quantify the link performance.