



Training Program : Point-to-Point Radio Link Design

Course : Introduction & Basics

COMPLEMENTS to Lesson 3 : Link Budget and Fade Margin

A test for Fade Margin

After installation of a Radio Hop, a test can be executed to check the agreement between Link Budget computations and field measurements. The test must be performed under ideal propagation conditions, when we expect that path attenuation is close to Free Space Loss (typically around midday, with well mixed atmosphere, avoiding atmospheric anomalies like a sharp temperature gap between the ground and the atmosphere).

An attenuator is added at the transmitter site, at the radio equipment output. The attenuation is increased until the BER at the far end receiver is at the performance threshold. The attenuator level is a measure of path Fade Margin (how much attenuation the radio hop can suffer before reaching the performance threshold).

If the measured Fade Margin is not in agreement with Link Budget prediction, some unexpected impairment should affect the Radio Hop. The same procedure can be repeated at the receiver site, with the attenuator at the radio receiver input. When this Fade Margin measure is in better agreement with Link Budget computations, then it is concluded that some interference is likely to degrade the hop performance. On the other hand, if both measurements give a similar result, with the Fade Margin significantly lower than the computed one, then it is likely that the receiver is defective in some sub-system.

Receiver Threshold Degradation

It may appear counter-intuitive that, when speaking of "Threshold Degradation", this corresponds to an increase in Rx threshold.

Actually, Ground Reflections and Interference do not produce any attenuation in Rx signal power, rather they impair detection at the receiver.

Therefore, we require a higher Rx signal level to compensate for the impairment caused by reflections and/or Interference. This justifies an increase in Rx threshold.

Quite often, the design criterion in dealing with interference is to limit threshold degradation caused by interference to some moderate value (some 2 - 3 dB).

Useful References

[1] [ITU-R, Handbook - RADIOWAVE PROPAGATION INFORMATION FOR DESIGNING TERRESTRIAL POINT-TO-POINTS LINKS, Radiocommunication Bureau, 2008](#)

[2] [Kizer G., Digital Microwave Communications - Engineering Point-to-Point Microwave Systems, IEEE Press, John Wiley & Sons, 2013](#)