DEGRADATION OF PERFORMANCE DUE TO SHORT TERM INTERFERENCE - METHODOLOGY DESCRIPTION

The degradation of performance, DP, of the total link objective due to interference is computed per the equation below:

$$DP = \frac{P_2 - P_1}{P_1} \times 100 \qquad (1)$$

P_1 is the FS link's **target unavailability (or outage probability)**, defined as the probability that the fade F(t) exceeds a certain fade depth, referred to as Flat Fade Margin (FFM). Exemplary values for P_1 are 0.01% and 0.001%, resp., corresponding to target availabilities of 99.99% and 99.999%.

$$P_1 = P(F(t) > FFM), \qquad (2)$$

FFM is a function of the pre-defined target availability. To determine the value of FFM, the multipath occurrence factor, p_0, is computed according to ITU-R Rec. P.530-17 (section 2.3.2, equation 11) using the following input parameters: FS Transmitter (Tx) and Receiver (Rx) terrain heights, antenna heights above ground level, link distance, and center frequency.

The FFM corresponding to the FS link's target availability and the multipath occurrence factor p_0 is then obtained from ITU-R Rec. P.530-17 (section 2.3.2, equation 18).

P_2 in Equation 1 is the outage probability in the presence of fading F(t) and interference I(t). It is defined as the probability of link attenuation caused by the cumulative effect of interference and fading being higher than FFM.

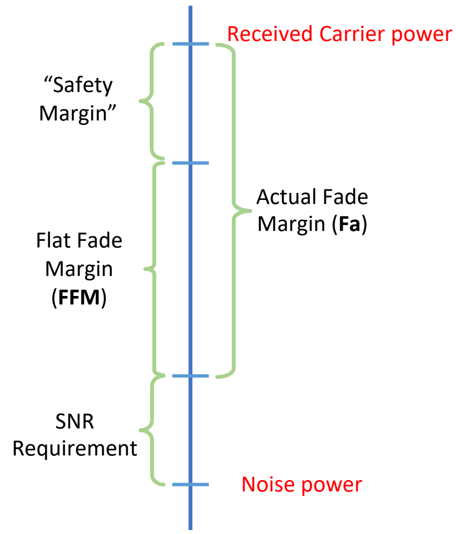
$$P_2 = P\left(F(t) + 10 * \log\left(1 + 10^{0.1\frac{I(t)}{N}}\right) > FFM\right) \qquad (3)$$

DP can now be computed as per Equation (1). The typical or, in other words the maximum allowable degradation value used in ITU-R recommendations is DP = 10% (Rec. ITU-R F.1494, Rec. ITU-R S.1323-2).

Actual Fade Margin vs. Flat Fade Margin

In real point-to-point wireless link deployments, additional "safety margins" may be applied. In these cases the actual fade margin (Fa) will be higher than the FFM (Figure 1).

Figure 1: FS Fade margins



Due to this increased fade margin, the actual link availabilities will be higher than the target availabilities.

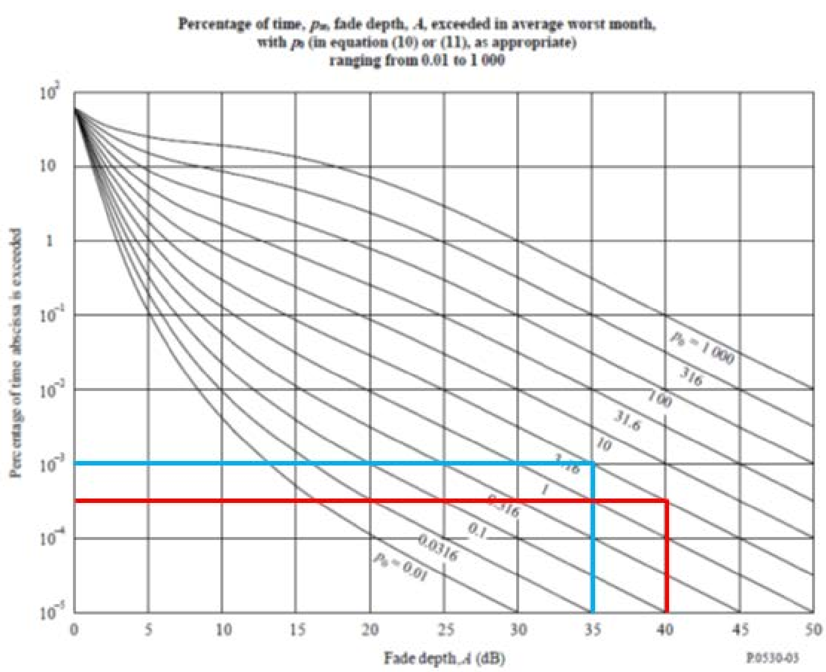
An example is shown in Figure 2.

For a value of p_0 = 3.16 and a targeted outage probability P_1 = 0.001% (corresponding to a link availability of 99.999%), the resulting FFM is 35 dB.

Assuming a "safety margin" of 5 dB, the resulting **actual fade margin** Fa = FFM + 5 dB = 40 dB.

As per Figure 2, for a fade margin of 40 dB the **actual outage probability** P_1' is approximately 0.0002%, corresponding to an **actual link availability** of 99.9998%.

Figure 2: Relation between p_0, P_1, and fade depth (from ITU-R Rec. P.530-17)



P_2' is the **actual outage probability** in the presence of fading F(t) and interference I(t). As the actual outage probability is determined by the **actual fade margin (Fa)** (and not FFM), P_2' is defined as the probability of link attenuation caused by the cumulative effect of interference and fading being higher than Fa.

$$P_2{}' = P\left(F(t) + 10 * \log\left(1 + 10^{0.1\frac{I(t)}{N}}\right) > Fa\right) \qquad (4)$$

The maximum allowable degradation of performance, however, is set with respect to the specified target unavailability P_1 (and not the actual unavailability P_1'). Therefore, Equation (1) can be written as:

$$DP = \frac{P_2{}' - P_1}{P_1} \times 100 \qquad (5)$$

In case of no interference, Equation (4) becomes

$$P_2{}' = P(F(t) > Fa)$$

In this case, the degradation of performance DP becomes negative which means that the performance, i.e. actual link availability, increases **over the specified target value**, as described in the above example.