PLAINTREE

OPTICAL POWER MARGIN OR "FADE MARGIN"

Defining Fade-Margin

The maximum allowable link length, that is the distance between two WaveBridge units, depends upon a number of factors. This is of course, is true for any wireless link.

Plaintree specifies a guaranteed fade-margin for a standard link of 1 km, in "clear weather" conditions. This fade-margin represents the amount of excess power available at each receiver, over and above what is necessary to provide connectivity, in clear weather. This does not indicate that only 1km links should be deployed. However, Plaintree recommends that all links be installed such that there is some excess fade-margin. This power allows the link to withstand adverse atmospheric effects (bad weather) such as rain or fog. A table of weather conditions and their different attenuation factors for infrared light is shown below.

It is common practice for all wireless links to budget the transmit power to balance the worst case of atmospheric attenuation against the desired level of availability. For a given link, the greater the fade-margin, the greater the availability.

Fade-Margin Calculations

It is possible to calculate the expected margin at a given distance and for different weather conditions. The following formula can be used. Note that the calculated figures are approximate, results may vary slightly between installed links.

M(L) = $M(1) + 0.5 - AL - 20 \log_{10}(L)$ dB

M(L) = margin of the link at length L

L = length of link

A = atmospheric attenuation in dB/km (see Table 1)

M(1) = margin at 1 km (as specified in the Plaintree product literature).

20log (L) = Geometric attenuation factor by dispersion of the beam of light

For 100 % availability, the value of M(L) must be greater than zero for the largest value of A that will occur.

Example

As an example, the following is a plot of fade-margin versus distance for a Plaintree WaveBridge PWTA525 in four common weather conditions. For link availability, the lines must be above zero at a chosen distance.

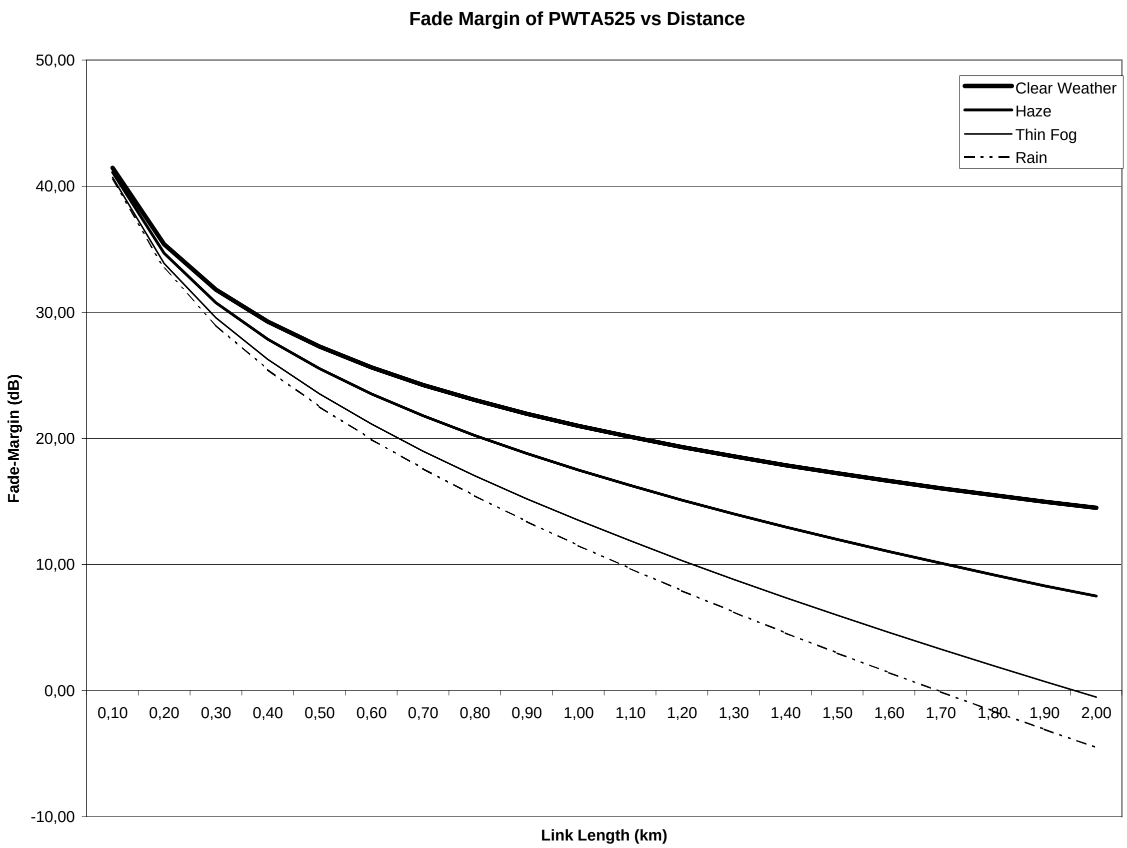

Figure 1

Atmospheric Conditions

Attenuation factors for common weather conditions:

WEATHER CONDITION	ATTENUATION (dB/km)
Clear Weather	0.5 dB/km
Haze	4 dB/km
Thin fog	8 dB/km
Rain	10 dB/km
Light fog	15 dB/km
Very heavy Rain	17 dB/km
Moderate fog	28 dB/km
Dense fog	>60 dB/km

Table 1

Decibels (dB)

Decibels are by definition, a logarithmic measure or "scale". Logarithmic scales are useful for looking at numbers that vary from very small numbers to very large numbers. Fade-Margin and Attenuation both vary in this way, and here they are described in dB. The chart below shows a few different fade-margins in dB, and beside it the meaning in terms of the physical power it represents.

FADE MARGIN (dB)	PHYSICAL REPRESENTATION
20 dB	= 100 times the power required for connectivity
10 dB	= 10 times the power required for a connectivity
3 dB	= 2 times the power required for a connectivity

Table 2

Clear Weather

Clear weather conditions are defined as visibility of 25 miles (40km) or more. This type of weather statistic is available from a variety of sources - including airports, meteorological institutes and other reputable published sources.

Attenuation

Attenuation is the reduction or degradation of signal strength during transmission. It is the exact opposite of amplification, and attenuation is a physical consequence of sending a signal is sent from one point to another. If the signal attenuates (degrades) too much, it becomes unintelligible. Attenuation is commonly measured in dB.