The WaveRider EUM3000 achieves non line-of-site (NLOS) performance by taking advantage of the superior propagation characteristics of the lower frequency 902-928 MHz band.

It is a simple fact of physics that lower frequency radio energy travels farther though cables, through the air, through and around clutter like trees, hills and buildings. In this note we provide some examples of propagation loss to be expected in the 902 MHz band, the 2.4 GHz band, and the 5.8 GHz band.

These advantages of 902 MHz mean that more subscribers are accessible from a given base station. It usually allows for the use of inexpensive indoor antennas, or under-the-eaves outdoor subscriber antennas. These antennas are less costly to install and maintain, less obtrusive, and avoid subscriber reluctance to deal with rooftop masts.

Free Space Loss – the loss due to radio energy passing through air with a clear Fresnel zone(1)

Generally, a 902 Mhz signal travels through air with much less loss than does a higher frequency signal.

	902MHz	2.4GHz	5.8GHz
Example – 3 miles:	105.2 dB	113.7 dB	121.3 dB

Cable Loss – the loss expected due to radio energy passing through RF cables(2)

	902MHz	2.4GHz	5.8GHz
Example – 150 feet, LMR400	5.9 dB	10.0 dB	16.1 dB
Example – 150 feet, LMR900	2.6 dB	4.4 dB	7.2 dB
Example – 150 feet, LMR1200	1.9 dB	3.4 dB	5.6 dB

Vegetation Loss – the loss expected due to radio energy being absorbed by the moisture content of the vegetation.

This loss will vary for every situation, however the typical tree loss expected at different frequencies has been estimated by the International Telecommunication Union:(3)

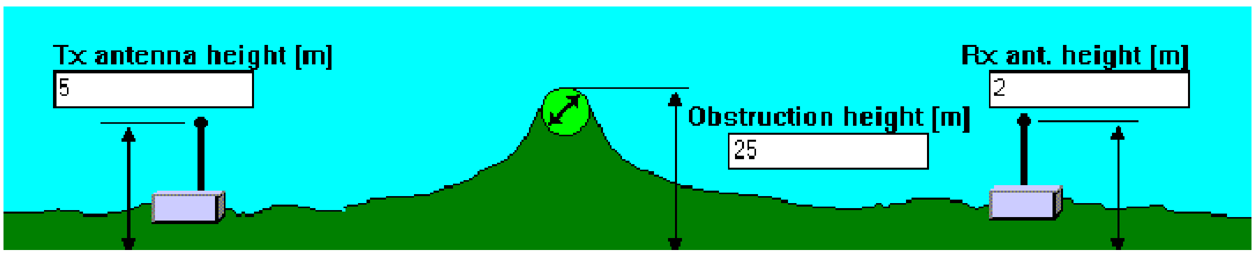
	902MHz	2.4GHz	5.8GHz
Example – 150 feet of trees	9 dB	25 dB	60 dB

Wall and Glass Loss – the loss expected due to radio energy being absorbed while passing through the walls and windows of a building.

The amount of absorption varies depending on the construction materials and thickness of the material. Generally more energy is absorbed at the higher frequencies.

Gains from Reflection – in the real world radio energy does not follow just one path from the transmitter to the receiver. In a cluttered NLOS environment (for example lots of buildings surrounding the receiving modem), the received signal is really the sum of many signals that have reflected off surrounding buildings, the ground, trees etc. With higher frequencies, more of the signal gets absorbed during a reflection. With lower frequency 902 MHz signals, more energy will ultimately reach the receiving antenna, benefiting from the reflections.

Gains from Diffraction – Diffraction is what happens when a radio signal "bends" around an obstacle, like a hill, a building or a tree. For example if a 902 MHz base station antenna is located out of or above the trees, than a diffractive path can exist around the trees, giving a much stronger link. This benefit is not available to the same extent at higher frequencies. The following diagram shows an example where a signal may diffract around a hill to reach a receiving antenna in the "shadow" of the hill.



Sources:
1. Use the common formula: Free Space Loss = 20Log10(Frequency in MHz) + 20Log10 (Distance in km) + 32.4
2. See http://www.timesmicrowave.com/calculators/index.htm
3. See the ITU Recommendation: ITU-R P.833-3 "Attenuation in vegetation" 2001
   http://www.itu.int/rec/recommendation.asp?type=items&lang=e&parent=R-REC-P.833-3-200102-I