Department of Electronic and Telecommunication Engineering

University of Moratuwa, Sri Lanka

EN 2053 - Communication Systems and Networks

Assignment on Wireless Communication

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Contents

1 Modeling the RF propagation Model Using Matlab

1.1 Relationship between Free Space Path Loss and Frequency

Consider following meanings for the parameters

P_{RX}	= Received Power at the Receiving Antenna
P_{TX}	= Transmitted Power at the Transmitting Antenna
f	= Frequency of the wave in Hz
f_{GHz}	= Frequency of the wave in GHz
d	= Distance between the antennas in m
d_{km}	= Distance between the antennas in km
G_{TX}	= Directive gain of the Transmitter
G_{RX}	= Directive gain of the Receiver
c	= Velocity of the electromagnetic waves in a vacuum

The relationship between above parameters can be given as follows

$$P_{RX} = P_{TX} \cdot \frac{c^2}{(4\pi.f.d)^2}.G_{TX}.G_{RX}$$

From the above equation, free space path loss, say L

$$L = \frac{(4\pi.f.d)^2}{c^2}$$

By considering $10.log_{10}()$ in both sides, Free Space Path Loss in dB, say L_{dB}

$$\begin{aligned}
\log_{10}(L) &= 10.\log_{10}(\frac{(4\pi.f.d)^2}{c^2}) \\
L_{dB} &= 10.\log_{10}((4\pi.f.d)^2) - 10.\log_{10}(c^2) \\
&= 20.\log_{10}(4\pi.f.d) - 20.\log_{10}(c) \\
&= 20.\log_{10}(4\pi) - 20.\log_{10}(c) + 20.\log_{10}(f) + 20.\log_{10}(d) \\
&= 20.\log_{10}(\frac{4\pi}{c}) + 20.\log_{10}(f) + 20.\log_{10}(d) \\
&= -147.5522168 + 20.\log_{10}(f_{GHz}.10^9) + 20.\log_{10}(d_{km}.10^3) \\
&= -147.5522168 + 20.\log_{10}(10^9) + 20.\log_{10}(f_{GHz}) + 20.\log_{10}(10^3) + 20.\log_{10}(d_{km}) \\
&= -147.5522168 + 180 + 20.\log_{10}(f_{GHz}) + 60 + 20.\log_{10}(d_{km}) \\
&= -147.5522168 + 240 + 20.\log_{10}(f_{GHz}) + 20.\log_{10}(d_{km}) \\
&= +92.44778322 + 20.\log_{10}(f_{GHz}) + 20.\log_{10}(d_{km})
\end{aligned}$$

Since transmitter and receiver are located at distance of 10km apart, by substituting $d_{km} = 10$.

Free Space Path Loss in dB, L_{dB} as a function of frequency in Giga Hertz

$$L_{dB}(f_{GHz}) = +112.44778322 + 20.\log_{10}(f_{GHz})$$

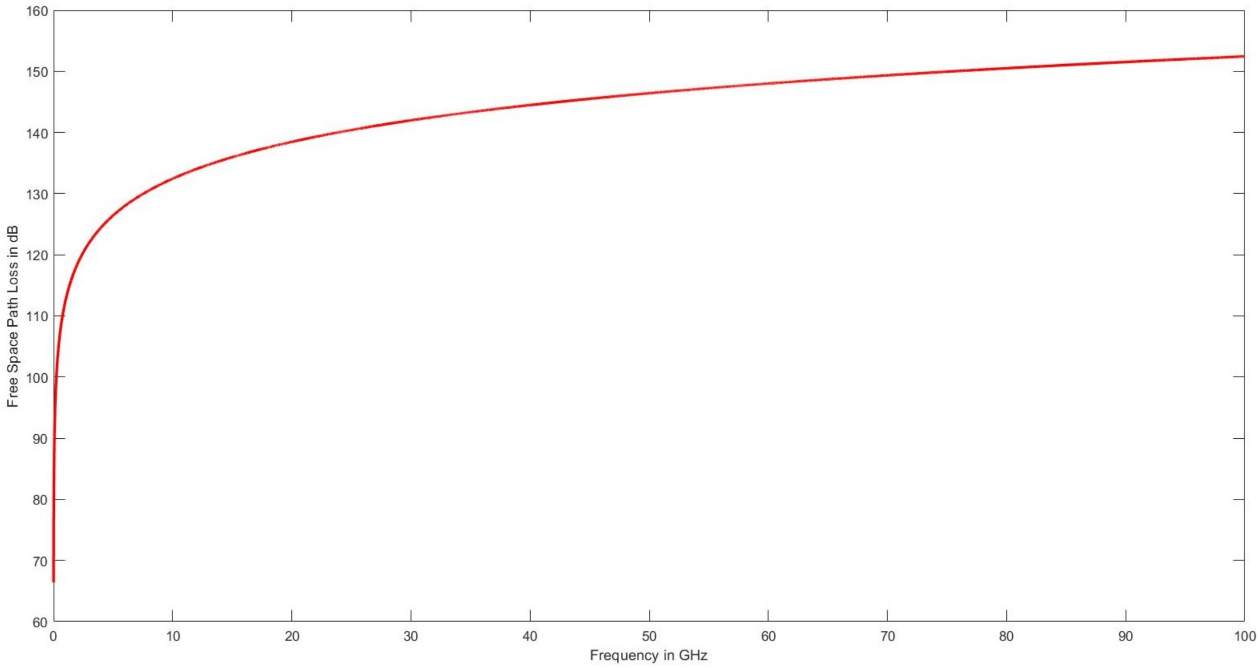

Figure 1: Relationship between Free Space Path Loss and Frequency

1.2 Rain attenuation, Fog attenuation and Atmospheric gas attenuation with Frequency

1.2.1 Rain attenuation

1.2.2 Fog attenuation

1.2.3 Atmospheric gas attenuation

1.3 Total Path Loss with Frequency

1.4 Codes and Models