Appendix E

Calculating Adjacent Channel Separation and Interoperability Distances

Calculating Required Path Loss and Corresponding Distance

Adjacent channel separation and interoperability distances were calculated for the 25 kHz and 12.5 kHz receivers by first determining the required path loss by using the following equations and assumptions:

(Eq. E-1) $P_R = P_T + G_T + G_R - L_S - L_P$

where:

P_R = Power at receiver input (defined below), dBm
P_T = Transmitter Power, dBm
G_T = Transmitter Antenna Gain Towards Receiver, dBi
G_R = Receiver Antenna gain Towards Transmitter, dBi
L_S = System Loss, dB
L_P = Required Path Loss, dB

with:

P_T = 44, 37, and 30 dBm
G_T = 3 dBi
G_R = 3 dBi
L_S = 2 dB

Rearranging equation E-1 to solve for the required path loss, L_P, results in equation E-2.

(Eq. E-2) $L_P = P_T + G_T + G_R - L_S - P_R$

For the adjacent channel separation distances, the required path loss was calculated by using the above assumptions and setting the received power, P_R, equal to the received interference power values in Tables A-1, A-2, and A-7 of Appendix A.

For the interoperability distances, the required path loss was calculated by using the above assumptions and setting the received power, P_R, equal to the received desired signal power values in Tables B-1 and B-2 of Appendix B.

Once the required path loss values were calculated, the adjacent channel separation and interoperability distances were determined by reading the appropriate value of distance that corresponds to the required path loss on Figures E-1, E-2, and E-3. These figures were created using the NTIA nlambda propagation model for smooth earth at 157.1 MHz over seawater with vertical polarization at the 50 percentile. Three cases of transmit and receive antenna heights were considered: 3 m, 3 and 10 m, and 10 m. These cases were done to model communications between recreational boaters, recreational and commercial boaters, and commercial boaters. Higher antenna heights increase the radio line-of-sight distance and alter the path loss values.

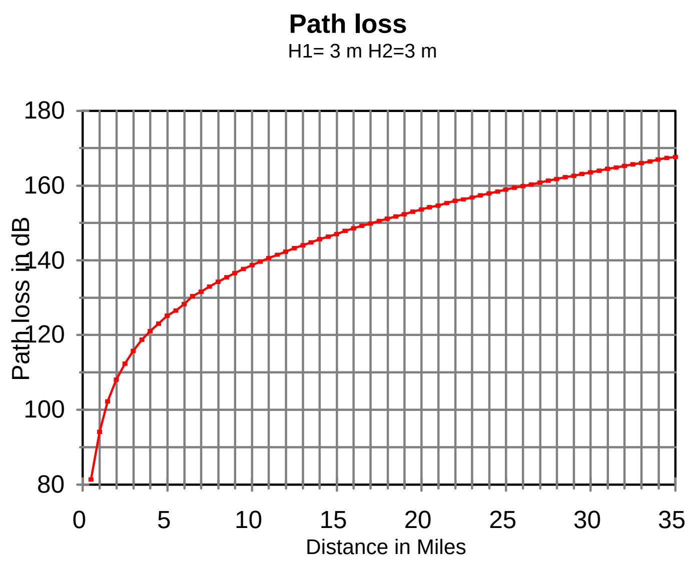

Figure E-1
Path Loss Distance Curve, 3 m and 3 m

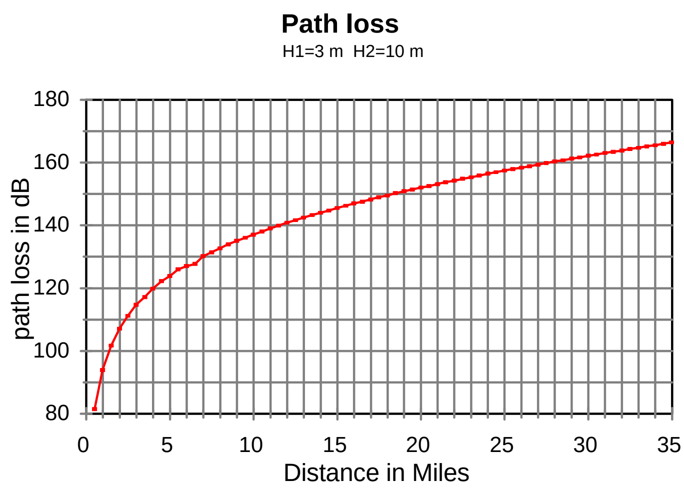

Figure E-2
Path Loss Distance Curve, 3 m and 10 m

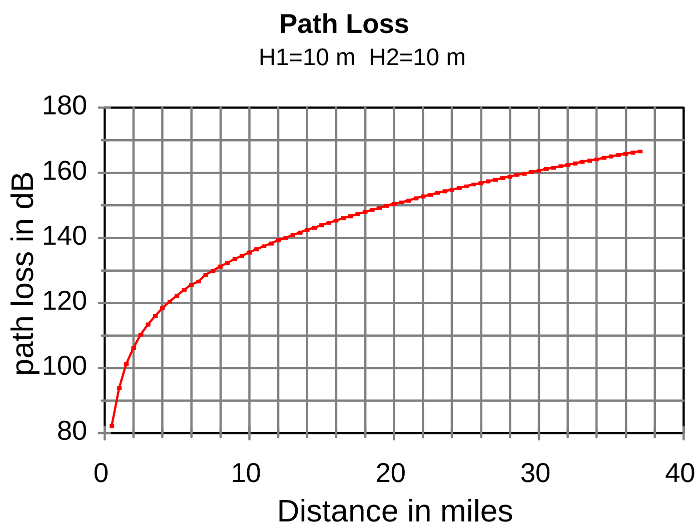

Figure E-3
Path Loss Distance Curve, 10 m and 10 m

Sample Calculations

The following paragraphs contain sample calculations for determining the adjacent channel separation and interoperability distances for receiver A, a 25 kHz radio. The same methodology applies to all other 25 and 12.5 kHz radios.

Adjacent Channel Separation Distance

The received interference power for Receiver A in column four of Table A-1 is -59 dBm for a 25 kHz interferer off-tuned by -25 kHz from the desired signal. The received interference power for receiver A from a 12.5 kHz interferer off-tuned by 12.5 kHz is -97 dBm (column 6 of Table A-2).

Setting P_R in equation E-2 equal to -59 and -97 dBm and using the other assumptions, the required path loss can be calculated for receiver A versus the 25 kHz and 12.5 kHz interferers at each level of interferer transmitter power. The results are 107, 100 and 93 dB, and 145, 138 and 131 dB, respectively.

The corresponding distance for each required path loss can then be determined by using the appropriate figure for the selected antenna heights. For example, for a required path loss of 107 dB the corresponding distance for antenna heights of 3 meters can be determined from Figure E-1 to be approximately 1.5 miles. For a required path loss of 145 dB, the corresponding distance for antenna heights of 3 meters can be determined from Figure E-1 to be approximately 13.5 miles. Figure E-2 can be used to determine the adjacent separation distances for antenna heights of 3 and 10 meters. Figure E-3 can be used to determine the adjacent channel separation distances for antenna heights of 10 meters.

Adjacent channel separation distances for different scenarios/situations can be determined from the figures by changing the assumptions for antenna gain and system loss in equation E-2.

Interoperability Distance

The desired signal power for Receiver A in column two of Table B-1 is -111 dBm for a 12.5 kHz transmitter and in column three is -114 dBm for a 25 kHz transmitter.

Setting P_R in equation E-2 equal to -111 and -114 dBm and using the other assumptions, the required path loss can be calculated for receiver A communicating with the 12.5 kHz and 25 kHz transmitters. The results are 159, 152 and 145 dB, and 162, 155 and 148 dB, respectively.

The corresponding distance for each required path loss can then be determined by using the appropriate figure for the selected antenna heights. For example, for a required path loss of 159 dB, the corresponding distance for antenna heights of 3 meters can be determined from Figure E-1 to be approximately 25 miles. For a required path loss of 162 dB, the corresponding distance for antenna heights of 3 meters can be determined from Figure E-1 to be approximately 28 miles. Figure E-2 can be used to determine the interoperability distances for antenna heights of 3 and 10 meters. Figure E-3 can be used to determine the interoperability distances for antenna heights of 10 meters.

Interoperability distances for different scenarios/situations can be determined from the figures by changing the assumptions for antenna gain and system loss in equation E-2.

Conversion To Nautical Miles

The distances chosen from the figures are in statute miles. They were converted to nautical miles in the main report by multiplying by .87.