Transmission Path Calculation for Transatlantic VHF Test VO1/EI

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Reference: Einführung in die Radartechnik, Prof. B. Schiek, Univ. Bochum, Germany

Geometry setup

Distance from source to first reflection [m] $R1 := 900km$

First reflection area size [m^2] $Ar1 := 10^4 \cdot m \cdot m$

Distance first to second reflection [m] $R2 := 900 \cdot km$

First reflection area size [m^2] $Ar2 := 10^4 \cdot m \cdot m$

Distance from second reflection to target [m] $R3 := 900 \cdot km$

Transmitter & receiver setup

Frequency of operation [Hz] $f := 144 \cdot MHz$

Output power at transmitter $Pt := 600W$

TX & RX antenna gain over isotropic $Gdb := 15$

Calculation

Wavelength [m] $\lambda := \frac{3 \cdot 10^8 \cdot \frac{m}{s}}{f}$ $\lambda = 2.083\,m$

Antenna power gain $G := 10^{\frac{Gdb}{10}}$ $G = 31.623$

Antenna capture area [m^2] $A := \lambda^2 \cdot \frac{G}{4 \cdot \pi}$ $A = 10.922\,m^2$

Reflection object radar cross section $\sigma 1 := \frac{4 \cdot \pi \cdot Ar1^2}{\lambda^2}$ $\sigma 1 = 2.895 \times 10^8\,m^2$

Radar cross section is not the physical cross section!

$\sigma 2 := \frac{4 \cdot \pi \cdot Ar1^2}{\lambda^2}$ $\sigma 2 = 2.895 \times 10^8\,m^2$

Received power $Pe := \frac{Pt \cdot G}{4 \cdot \pi \cdot R1^2} \cdot \sigma 1 \cdot \frac{1}{4 \cdot \pi \cdot R2^2} \cdot \sigma 2 \cdot \frac{1}{4 \cdot \pi R3^2} \cdot A$

$Pdbm := 10 \cdot \log\left(\frac{Pe}{10^{-3} W}\right)$ $Pdbm = -137.832$

$U := \sqrt{Pe \cdot 50 \cdot ohm}$ $U = 2.87 \times 10^{-8}\,V$

Thermal noise power in 100Hz bandwidth $Pth := -154$ $SN := Pdbm - Pth$

Signal to noise ration in 100Hz BW $SN = 16.168$