SpaceRelays Optical Communication Assignment

This report presents an analysis of inter-satellite optical communication.

Assumptions:

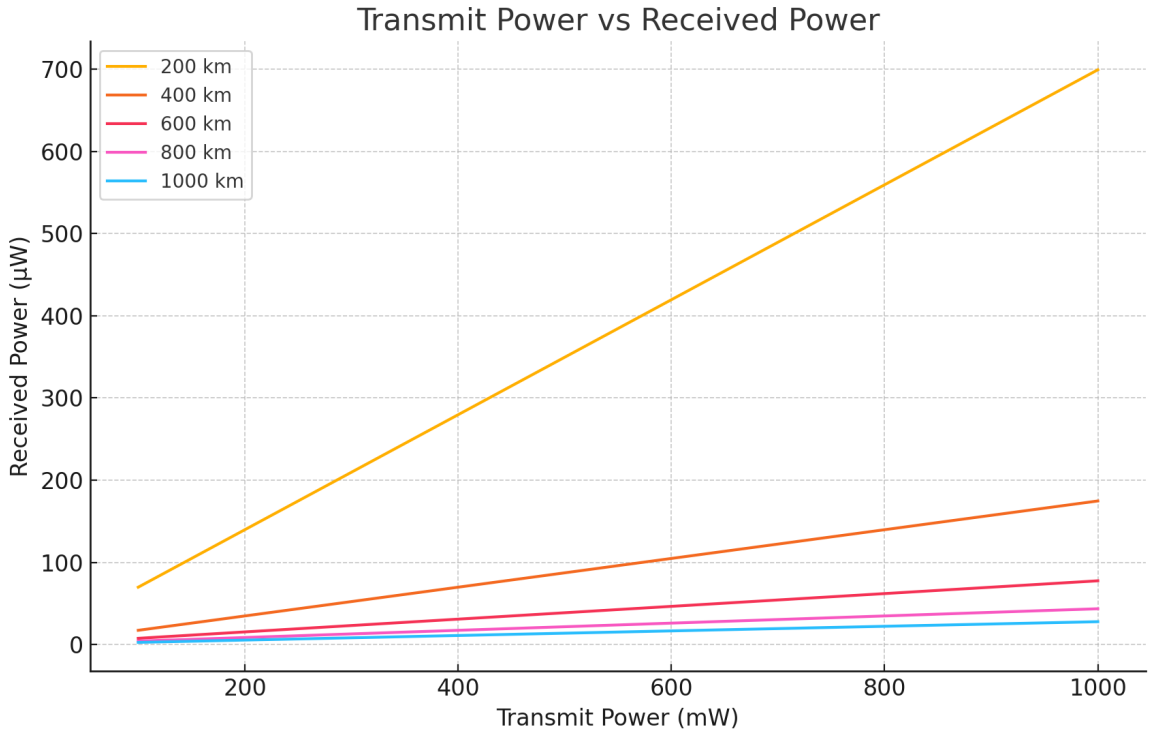
- Wavelength: 1550 nm
- Transmitter and Receiver Aperture: 10 cm
- Beam divergence (theta): 1.22 * wavelength / aperture
- Free-space vacuum: no atmospheric attenuation
- Transmission Power Range: 100 mW to 1 W
- Distances: 200 km to 1000 km
- SNR Range for OOK: -2 dB to 7 dB

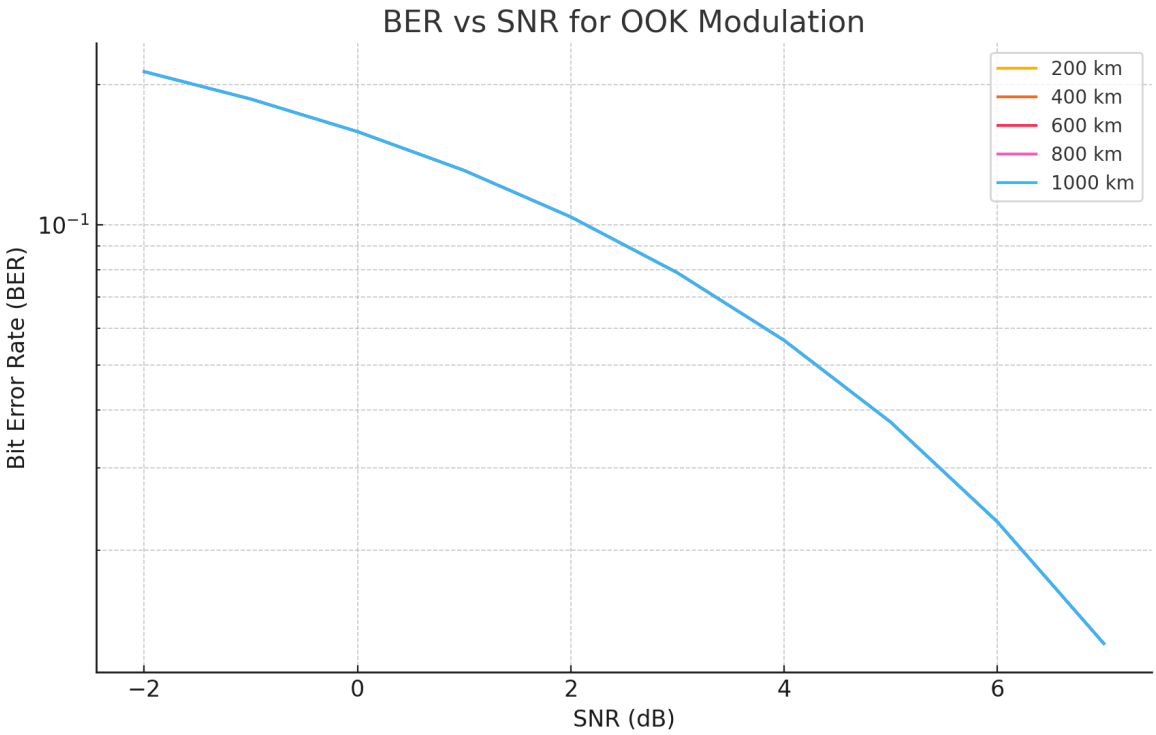
Equations Used:

1. Beam Divergence: theta = 1.22 * wavelength / diameter
2. Spot Area = pi * (distance * theta / 2)^2
3. Received Power = Transmitted Power * (Receiver Area / Spot Area)
4. BER for OOK: 0.5 * erfc(sqrt(SNR / 2))

Key Results:

- Received power decreases significantly with increasing distance due to beam spread.
- Higher Tx power increases received power linearly.
- BER improves with increasing SNR, as expected in an AWGN channel.


Transmit Power vs Received Power
200 km
400 km
600 km
800 km
1000 km
Received Power (μW)
0
100
200
300
400
500
600
700
200
400
600
800
1000
Transmit Power (mW)


BER vs SNR for OOK Modulation
200 km
400 km
600 km
800 km
1000 km
Bit Error Rate (BER)
10^{-1}
−2
0
2
4
6
SNR (dB)