ABSTRACT

Laser-based optical communication solutions have the potential to meet the needs of high-speed data transmission in satellite communication systems, especially for uplinks to low-earth orbit (LEO). The main problem raised is how to design an optimal laser uplink communication system and be able to overcome propagation constraints such as signal attenuation. This topic is important because conventional Radio Frequency (RF)-based communication systems have limitations in bandwidth and power efficiency, while laser technology offers higher bit rate capacity with lower interference. This study aims to design and optimize a laser uplink satellite communication system in LEO orbit. This study conducted simulations using OptiSystem 22 software with variations in bit rate (10 Gbps, 20 Gbps, 30 Gbps), wavelength (850 nm, 1310 nm, 1550 nm), distance (500 km, 1000 km, 1500 km), loss (33 dB, 35 dB, 37 dB, 39 dB, 41 dB), and gain (3, 5, 7). The research results were analyzed by examining the Bit Error Rate (BER), Optical Spectrum, and Optical Power values. After testing, the recommended bit rate of 10 Gbps, a wavelength of 1550 nm, and a distance of 500 km provide the best performance while minimizing loss. This research contributes to the design of an effective optical laser uplink system for use as an alternative to high-speed satellite communications.

Keywords: *Optical Communication, RF, LEO, Uplink, Bit Rate*