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# Optimization of High Speed and Long Haul Inter-Satellite Communication Link by Incorporating Differential Phase Shift Key and Orthogonal Frequency Division Multiplexing Scheme

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**Abstract:** Inter-Satellite optical wireless communication (Is-OWC) link plays significant role for transmission of data between the satellites in the space. In this work, 10 Gbps of data is transmitted over 20,000 km Is-OWC link by incorporating differential phase shift key (DPSK) modulation and orthogonal frequency division multiplexing scheme. Signal to noise ratio (SNR), total received power, constellations diagram and radio frequency spectrums are used as key metrics to evaluate the performance of proposed Is-OWC-DPSK communication system. Furthermore, the effects of receiving pointing error for proposed IS-OWC-DPSK communication system are also analysed.

**Keywords:** Inter-Satellite Link, Differential Phase Shift Key, Receiving Pointing Errors, Orthogonal Frequency Division Multiplexing

## I Introduction

In 1960's, Laser technology found its application in communication field mainly in space communication. Since then researchers has investigated and emerged out in a new and unbounded domain of communication named as optical wireless communication. In case of terrestrial applications, it is known as Free Space Optics [1, 2] whereas in case of space, this technology is renamed as inter-satellite optical wireless communication (Is-OWC) [3-5]. Is-OWC allows the communication between the satellites through laser signal. In this technique, data or information which has to be transmitted is modulated over optical signal by using carrier, generating from optical source such as laser, then this optical signal is transmitted through free space from one satellite to another satellite. In receiving satellite, light is demodulated into original transmitted information or data with the help of photo-detectors. Is-OWC technology allows satellite to make a pair with each other either from same orbits or with satellite in another orbit and high speed of light enables data transmission without delay and heavy payloads. Due to this, a huge reduction in the cost of heavy payloads can be made. Moreover, Is-OWC technology uses narrow beam lasers which further results in less loss of signal as compared to radio frequency communications [6].

Is-OWC technology uses the same basic structure as for optical fiber communication system, only the difference is using the free space as channel instead of optical fiber. It works on principle of line of sight

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