Chapter 4
Performance Analysis of FSO Links in Turbulent Atmosphere

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ABSTRACT

The free-space optical communications technology is emerging as an attractive substitute to RF communications. It can satisfy the current demands for higher bandwidth to the customer. Atmospheric turbulence is a major obstacle in wireless optical communication systems. To fully utilize the terabit capacity of FSO system, it has to overcome various challenges offered by the heterogeneous nature of the atmospheric channel. Currently, FSO communication through atmospheric turbulence under adverse weather conditions is an active research topic. A lot of studies and experiments have been carried out on the effect of attenuation due to atmospheric turbulence; but still, much more research is necessary for fulfilling the current demands and commercial needs for implementing this technology successfully. This chapter discussed the various limitations of FSO system which are faced during data transmission through the atmospheric channel and various ways to improve the performance regarding BER, outage probability, and channel capacity.

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INTRODUCTION

Free Space Optical communication (FSOC) or optical wireless communication (OWC) is an emerging technology that transmits data wirelessly under free space using the laser beam in Line Of Sight (LOS) connectivity. In recent years, free space optical (FSO) communication has gained notable interest over the other wireless RF technologies due to its unique features like significantly increased data rates, large bandwidth, license-free operation, easy and quick deployability, less power requirement, low maintenance cost, low mass requirement and improved security. The FSO technology is ideal and very much useful where the physical connections are impractical due to high cost or other considerations including temporary and rapid installation requirement for disaster recovery. Free-space optical links serve as a promising alternative to the conventional fiber optic cables used for backhaul links. Recent developments of optical technology have advanced FSO to make it an alternative to RF wireless communication.

Theoretically, FSO communication is the same as fiber optic transmission as both use the laser beam as the carrier. The only difference is the medium, where FSO technology sends the signal through the unguided medium (air or free space) rather than guided fiber optic cables. To provide a full-duplex transmission system using FSO technology it requires two systems, each consists of a low-power laser transmitter to transmit signal and a telescope used to receive the signal at the receiver. From the source terminal, the optically modulated signal is transmitted via laser beam and at the receiving point (consist of a high-sensitivity receiver telescope) a photo detector intercepts the beam, and the data is extracted by demodulation process.

Deployment of DWDM-based optical metropolitan area networks (MANs) is not sufficient to attain the high bandwidth demand. Therefore the wireless operators and service providers are forced to look for alternative way rather than RF spectrum to connect cells that may provide the high bandwidth demand. In this scenario, the free-space optical transmission is an excellent alternative to conventional communication technology. The FSO technology has proven itself a great success for LAN/ campus connectivity within short distance like a link between a newsroom and a broadcasting station, or a dedicated link between two high-traffic nodes in a large building complex.

Figure 1a shows the block diagram of a typical FSO communication system, where at the source terminal, the information source is optically