Atmospheric optical turbulence as a continuous shared key generator

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Abstract

Free space optical communication (FSOC) is rapidly developing new technology showing great promise for increased bandwidth, low latency and deployment flexibility (1). A major challenge to the reliable functioning of an FSOC system is posed by the atmospheric optical turbulence (OT). The OT is chaotic in nature and degrades the quality of an FSOC channel over distances above few tens of meters, in extreme cases, causing complete loss of connection. Another challenge is the security of the connection. That is currently guaranteed by encryption. However, the rapid advances in quantum computing and already existing algorithms (2), pose a big threat to maintaining the secrecy of the information.
The mitigation of OT effects is typically achieved using adaptive optics (AO). Central component of an AO is a wavefront sensor (WFS), used to measure the precise effects of the optical turbulence on the phase of the signal. We envision utilising the effects of the optical turbulence for the encryption of optical communication channel, using the fluctuations of the two dimensional distribution of the phase of the signal exchanged between both parties. In this paper, we will examine the feasibility of this idea. First using a simple computer model, and then a bench top setup simulating a link with moderate distance of about 1.5 kilometres. The results of this study will be presented first on this workshop.

(1) Free Space Optics (FSO) Communication Market Size By Platform, Global Market Insights. (November 2021).

(2) *Post-quantum cryptography*, D. Bernstein & T. Lange, Nature (2017)

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