

A Theoretical Review on Visible Light Communication (VLC) and Li-Fi Technologies: Advancements, Applications, and Challenges

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Abstract – Visible Light Communication (VLC) and Light Fidelity (Li-Fi) are emerging wireless communication technologies that utilize the visible light spectrum for data transmission, offering a promising alternative to traditional radio frequency-based systems like Wi-Fi. VLC leverages Light Emitting Diodes (LEDs) for communication, taking advantage of their ability to switch at high speeds, which is imperceptible to the human eye. This technology offers significant benefits, including high bandwidth, energy efficiency, security, and immunity to electromagnetic interference, making it ideal for use in environments where radio frequency communication is either impractical or undesirable. Li-Fi, an extension of VLC, provides bidirectional communication capabilities that enable high-speed internet access, secure data transmission, and efficient network management. With the increasing adoption of LED lighting systems in homes, offices, and public spaces, VLC and Li-Fi are positioned to revolutionize wireless communication by offering seamless integration with existing infrastructure. This paper reviews the development and principles of VLC and Li-Fi, highlights their potential applications, and discusses the challenges that must be addressed for their widespread implementation. Additionally, it explores the ongoing advancements in LED technology and modulation techniques that promise to enhance the performance of optical wireless communication systems.

Keywords – Visible Light Communication, Li-Fi, LED, Wireless Communication, Data Transmission, High-Speed Internet, Security, Optical Wireless Communication.