

Title: Full-duplex operations and reliability enhancement in indoor visible light communication networks

Abstract: Visible light communication (VLC) is a wireless communication technology that utilizes optical waves in the visible light range (300 nm - 700 nm) for transferring data. It usually consists of light-emitting diodes (LEDs) at the transmitters, which serve the dual purpose of a light source and a data transmitter. This work explores novel techniques to enhance indoor VLC networks by leveraging their inherent full-duplex capabilities, allowing simultaneous two-way communication, unlike traditional radio frequency (RF) systems, which operate in half-duplex mode. It addresses key challenges such as limited cell coverage and inter-cell interference by analyzing contention-based and contention-free MAC protocols of IEEE 802.15.7. A full-duplex optical MAC (FD-OMAC) is proposed for contention-free access, offering improved throughput and compatibility in multi-access point environments. The study also refines the Markov model analysis of CSMA/CA for better accuracy and evaluates full-duplex techniques like busy tone to address the hidden node problem. In addition, it presents hardware design and reliability analysis of full-duplex VLC transceivers using MTBF and life cycle cost modeling, facilitating more reliable and cost-effective indoor VLC systems.