Experimental Analysis of a Radio over Fiber Light Fidelity Network

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This work addresses the implementation and experimental evaluation of a light-fidelity (LiFi) system combined with a 5G radio-over-fiber (RoF) link. LiFi is exploited here as one of the main alternatives to Wi-Fi systems, which suffer from congestion due to an increasing number of user communication devices. Li-Fi is an adequate solution to Wi-Fi since it allows multi-user access and that several access points can be installed close to each other without interference, with the additional advantage that the frequencies used for Li-Fi (visible light spectrum) are not regulated. Li-Fi technologies are also more advantageous than Wi-Fi technologies since they can be a converged infrastructure, avoiding separate deployment of lighting and connectivity systems. The combination of a radio over fiber link with Li-Fi can for example be used for in vehicles such as cars and busses.

The end-to-end network is evaluated considering a client and server approach. The communication link is emulated by sending a non-return to zero (NRZ) optical signal modulated at 27 GHz to a photodiode, which then goes through antennas, and which is then converted back to an optical signal and finally to an ethernet signal before arriving at the LED light bulb of the LiFi system. The client is situated at the receiving end of network at the LiFi system. The proposed communication link can transmit data at various levels of brightness of the used LED. The performance analysis of the end-to-end network is carried out by measuring both data rate and latency for different LED brightnesses and packet sizes, as well as for distinct link architectures such as: back-to-back, optical link (5 km and 10 km), the link without the Li-Fi component and the complete end-to-end network. The data-rate is found to increase with increasing test packet size and increasing LED brightness, before saturating. A maximum data-rate up to 34.5 Mb/s was achieved for the whole link, whereas it goes up to around 1 Gb/s when removing the Li-Fi. The influence on the data-rate of the link of the signal's modulation frequency and of the power of the laser is also investigated. Finally, it is demonstrated that, for modulation frequencies measured between 24GHz and 32GHz, the link is functional for modulation frequencies equal to and greater than 26 GHz.

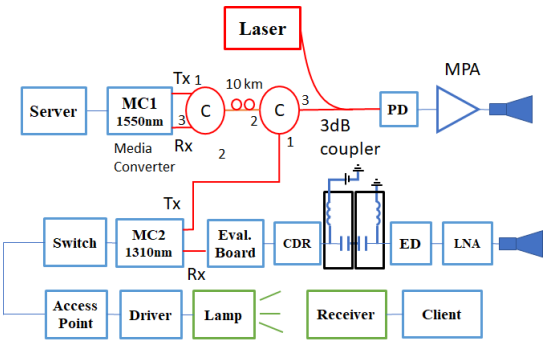

Figure 1: Simplified block diagram of the end-to-end RoF LiFi network. MC: Media Converter, PD: Photodiode, MPA: Medium Power Amplifier. LNA: Low Noise Amplifier. CDR: Clock- and Data-Recovery.

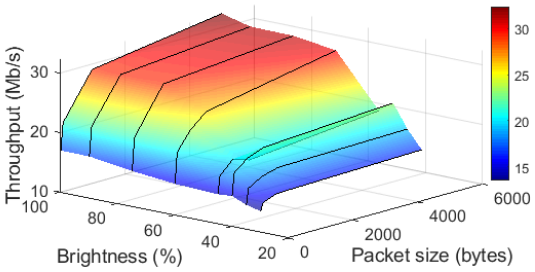

Figure 2: Transmission data rate in function of both brightness and packet size.