A Physical Layer Security Framework for Industrial Sensor Network Utilizing Integrated Infrared Handshaking and Visual Light Communication

Ramin Irani[1], Siamak Khatibi[2]

[1]) *Department of Computer Science*
Blekinge Tekniska Högskola
Karlskrona, Sweden
ramin.irani@bth.se
[2]) *Department of Technology and Aesthetics*
Blekinge Tekniska Högskola
Karlskrona, Sweden
siamak.khatibi@bth.se

The paper is submitted as: **Poster Presentation**

The rapid expansion of wireless sensor networks (WSNs)—which play a vital role in modern applications such as smart cities, industrial automation, healthcare, and defense—has intensified the need for secure and reliable communication frameworks. Traditionally, WSNs have relied on radio frequency (RF) technologies like Wi-Fi and Zigbee, which are prone to interference, eavesdropping, and jamming (Akyildiz et al., 2002). In light of these vulnerabilities, Light Fidelity (LiFi), a wireless communication technology that utilizes visible light for data transmission, has emerged as a promising alternative to enhance the security of WSNs. One of LiFi's key advantages is its confinement to physical spaces, as light signals cannot penetrate walls. This spatial limitation significantly reduces the risk of external interception and unauthorized access, making LiFi particularly suitable for sensitive environments where data confidentiality is critical.

This paper proposes a novel Physical Layer Security (PLS) framework for LiFi-based sensor networks in industrial settings. The system consists of multiple sensor nodes, each equipped with at least three radar sensors that integrate infrared (IR) and visible light communication (VLC) subsystems. The IR subsystem initiates a secure handshake protocol, activating the IR transmitter when data is ready and ensuring the receiver is prepared to establish a secure link. Following a successful IR handshake, the VLC subsystem handles data transmission between sensors. The IR subsystem also monitors for mobile obstacles and pauses communication if link discontinuities are detected, thereby preserving transmission integrity. Environmental features, such as walls, significantly affect the secrecy rate; thus, the system employs parallel alignment of transmitters and receivers to maximize the signal-to-background ratio.

Simulation results demonstrate the feasibility and effectiveness of the proposed architecture, highlighting its ability to enhance the robustness and security of inter-sensor communication in demanding industrial environments.