Department of Electrical, Electronics and Communication Engineering
GITAM School of Technology, Bengaluru-561203
GITAM (Deemed to be University)

Capstone Project – Introduction (PROJ2999), 7th Semester
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Project Title: DESIGN AND SIMULATION OF A RADIO-OVER-FIBER (RoF) SYSTEM FOR 5G BACKHAUL WITH 6G TERAHERTZ EXTENSIONS USING OPTISYSTEM

Guide Name: SUBHASHISH TIWARI

Section: B

Section Coordinator Name: Jaya Prakash Sahoo

Abstract:

This project presents the design and simulation of a Radio-over-Fiber (RoF) system for 5G backhaul with extensions toward 6G Terahertz (THz) communication using OptiSystem. RoF combines the high bandwidth and low attenuation of optical fiber with the flexibility of wireless links, making it a promising solution for next-generation high-capacity networks. In this work, a comprehensive RoF link was modeled to transport orthogonal frequency-division multiplexing (OFDM) signals, modulated with 64-QAM and 256-QAM formats, over single-mode optical fiber. The system employed external Mach–Zehnder modulation, optical amplification, and photodetection, followed by a wireless hop at millimeter-wave and THz frequencies. Key performance parameters such as Error Vector Magnitude (EVM), Bit Error Rate (BER), Q-factor, and constellation diagrams were analyzed across varying fiber lengths, optical wavelengths, and RF carrier frequencies. Results demonstrated that 64-QAM supports reliable transmission over 20–40 km with acceptable BER and EVM values, while 256-QAM requires short, high-SNR links. For the 6G extension, photonic generation via optical heterodyning enabled short-range THz links (140–300 GHz) with high-gain antennas, validating feasibility for ultra-high-speed communication. The findings confirm that RoF is a scalable and cost-effective backhaul solution for 5G, while photonic THz techniques hold strong potential for future 6G wireless networks.

Team Members (Name & Reg No.):

1. Bharath S R [BU22EECE0100440]
2. Gaganesh S R [BU22EECE0100470]