

ABSTRACT

This study aims to design a communication network system based on Free-Space Optic (FSO), Wi-Fi 6, and Fiber to the Building (FTTB) to overcome signal coverage limitations and dependence on conventional optical cables in the Tokong Nanas Building, Telkom University. This building is an academic activity center with a high number of users, so a fast, stable, and efficient network is needed. The methods employed include a simulation-based approach using OptiSystem software for the FSO system, topology simulation tools for the Wi-Fi 6 network, and OptiSystem, AutoCAD, and SketchUp for the FTTB design. The FSO system is configured as a point-to-point setup using a 1550 nm wavelength with a maximum distance of 3 km. The FTTB system uses a wavelength of 1490 nm for downstream and 1310 nm for upstream.

The samples in this study include communication paths from STO Cijawura to the Tokong Nanas Building, involving two hop points. Additionally, an analysis of the FTTB network design from the Mini OLT to the OTB and to the distribution panel on each floor was conducted, along with a Wi-Fi 6 network simulation based on user distribution and Access Point (AP) layout within the building. The analysis techniques include evaluating network performance through simulation results and financial feasibility analysis using the Net Present Value (NPV) and Internal Rate of Return (IRR) methods.

The results of the technical performance analysis show that the FSO and FTTB backbone systems meet the feasibility standards with a Bit Error Rate (BER) $\leq 10^{-9}$, Signal-to-Noise Ratio (SNR) ≥ 22 dB, Q-Factor ≥ 6 , and Link Power Budget (LPB) ≤ -28 dBm. The very low BER value indicates minimal data transmission errors, while the high SNR and Q-Factor indicate good signal quality. For the Wi-Fi 6 network, simulation results show a requirement of 158 APs, upper than the existing condition of 97 APs, with a Received Signal Strength Indicator (RSSI) > -67 dBm, which meets the feasibility standards for optimal connectivity. Financial analysis yields a Net Present Value (NPV) of Rp8.685.714.831,00 and an Internal Rate of Return (IRR) of 30%, both exceeding the feasibility thresholds of NPV > 0 and IRR $> 6\%$.

Keywords: Bit Error Rate, Fiber to the Building, Free-Space Optic, Internal Rate of Return, Link Power Budget, Net Present Value, Q-Factor, Signal-to-Noise Ratio, Wi-Fi 6