

ABSTRACT

Maintaining reliable and high-quality connectivity for passengers along the Jakarta-Surabaya high-speed railway LTE serves to elevate the user experience throughout their journey. This study aims to realize LTE networks with access points located in carriages under a distributed Mobile Switching Center (MSC) configuration, along with the incorporation of a fiber-optic-radio (FO-RF) transmission system for real-time seamless mobility.

Technical performance assessments show that one-way delays along the FO–RF path range between 50.17 ms and 60.23 ms, while round-trip delays remain below 150 ms—within LTE’s acceptable limits. Additionally, optimized intra-train communication using onboard routers and Wi-Fi access points achieves internal delays of under 8 ms, ensuring stable communication between carriages.

Network optimization significantly improves signal quality and transmission performance: average RSRP increased by 17.42%, RSRQ by 12.42%, and throughput by 15.73%, while latency decreased by 90.57%, jitter by 86.81%, and packet loss by 74.19%.

Economically, the system demonstrates high feasibility with a Net Present Value (NPV) of approximately IDR 333 billion, an Internal Rate of Return (IRR) of 17.87%, and a payback period of less than one year. Sensitivity analysis confirms the project’s resilience across varied scenarios of capital and revenue sharing between stakeholders. This comprehensive approach offers a technically sound and economically viable solution for modernizing long-distance railway communication infrastructure in Indonesia.

Keywords: LTE, High-Speed Railway, Techno-Economic Study, Passenger Communication, Optimization.