ABSTRACT

The Whoosh KCIC High Speed Railway is a national strategic project that relies on communication systems for its operation. However, the current communication system has limitations in terms of capacity, network coverage, and flexibility. This becomes critical amid the surge in demand for digital data exchange. Without improvements, these limitations could hinder real-time interaction between the train and the control center, which is vital for train movement control, emergency response, and accurate decision-making..

This study aims to design and analyze a more efficient and reliable wireless communication system for the Whoosh KCIC high-speed rail line between Padalarang Station and Tegalluar Summarecon Station. Through an in-depth analysis of signal range, physical obstacle penetration capability, and bandwidth capacity, the LTE-R system at 450 MHz was selected as the preferred solution because it can provide broader coverage with fewer of sites, thereby reducing installation and maintenance costs for the infrastructure.

The research results show that the design of the LTE-R network infrastructure connecting Padalarang Station and Tegalluar Summarecon Station was successfully implemented with the establishment of five site locations based on coverage planning calculations. RSRP measurements indicate superior signal strength with an effective cell radius of 3.2188 km, with most areas showing RSRP values between -40 dBm and -85 dBm, averaging -69.75 dBm. Additionally, SINR measurements confirm stable and robust communication, supported by an average C/[I+N] ratio of 32.09 dB. DL throughput shows stable performance, with most coverage areas achieving data rates between 13 Mbps and 26 Mbps, averaging 22.08 Mbps. BER analysis highlights the significant impact of modulation schemes on data transmission success rates. With a target of 10^{-4} at a SINR of 32.08 dB, the BER for QPSK was recorded at 10^{-6}, while 16-QAM and 64-QAM showed 10^{-4} and 10^{-3} respectively, emphasizing the urgency of selecting the appropriate modulation strategy.

Keywords: Bit Error Rate, Carrier-to-Interference-plus-Noise, Downlink Throughput, Kereta Cepat Indonesia China*, LTE-R, Modulation, Reference Signal Received Power, Signal to Interference-plus-Noise Ratio, Whoosh High-Speed Railway.*