RINGKASAN

Perkembangan teknologi *Internet of Things* (IoT) telah mendorong kebutuhan akan jaringan komunikasi nirkabel yang efisien dan andal, salah satunya adalah LoRa (*Long Range*) yang memiliki keunggulan dalam hal jangkauan luas dan konsumsi daya rendah. Namun, implementasinya di lingkungan *indoor*, seperti gedung bertingkat, menghadapi tantangan berupa penurunan kualitas sinyal akibat struktur fisik bangunan seperti dinding dan lantai. *Gateway* LoRa telah dipasang di beberapa lantai Gedung Kantor X, tetapi belum terdapat evaluasi sistematis terkait bagaimana sinyal terdistribusi dan apakah posisi *gateway* yang ada sudah optimal dalam menjangkau seluruh area dalam gedung secara merata.

Penelitian ini bertujuan untuk menganalisis distribusi kualitas sinyal LoRa berdasarkan parameter *Received Signal Strength Indicator* (RSSI) dan *Signal-to-Noise Rasio* (SNR), serta mengevaluasi hubungan antara posisi *gateway* dengan persebaran sinyal. Algoritma *K-Means Clustering* diterapkan untuk mengelompokkan titik pengukuran berdasarkan kualitas sinyal yang diterima.

Berdasarkan hasil penelitian, klasterisasi terhadap 119 titik pengukuran yang tersebar di 16 lantai Gedung Kantor X menghasilkan enam klaster yang merepresentasikan tingkat kualitas sinyal dari sangat buruk hingga sangat baik. Distribusi kualitas sinyal menunjukkan pola yang tidak merata, di mana lantai-lantai seperti 5, 9, dan 13 didominasi oleh klaster sinyal sangat baik, sementara lantai *ground*, *mezzanine*, 1, 14, dan 15 banyak ditemukan klaster dengan kualitas rendah hingga sangat buruk. Beberapa titik dengan kualitas sinyal buruk bahkan berada dekat dengan *gateway*.

Kata kunci: LoRa, IoT, *K-Means*, Klasterisasi, RSSI, SNR

SUMMARY

The growth of Internet of Things (IoT) technology has driven the need for efficient and reliable wireless communication networks, one of which is LoRa (Long Range), which has advantages in terms of wide coverage and low power consumption. However, implementing this technology in indoor environments, such as high-rise buildings, poses significant challenges due to signal quality degradation resulting from the physical structure of the building, including walls and floors. While LoRa gateways have been installed on various floors of Office Building X, a systematic evaluation of the signal distribution and the optimality of the existing gateway positions in terms of uniform coverage throughout the building is still not available.

The objective of this research is to analyze the distribution of LoRa signal quality based on Received Signal Strength Indicator (RSSI) and Signal-to-Noise Ratio (SNR) parameters, and to evaluate the correlation between gateway position and signal distribution. The K-Means Clustering algorithm is used to group measurement points based on received signal quality.

From 119 measurement points across 16 floors, six clusters were identified, representing signal quality levels from very poor to very good. The signal quality distribution was uneven, with floors 5, 9, and 13 dominated by excellent clusters, while the ground, mezzanine, 1st, 14th, and 15th floors were dominated by poor to very poor signal clusters. Notably, some points with poor signal quality were located near gateways, indicating that proximity alone does not guarantee good signal reception in complex indoor environments.

Keywords: LoRa, IoT, K-Means, Clustering, RSSI, SNR