ABSTRAK

Penerapan konsep *Smart Factory* di Kawasan Industri Rancaekek menuntut infrastruktur telekomunikasi yang mampu mendukung konektivitas masif bagi ribuan perangkat *Internet of Things* (IoT). Namun, jaringan seluler eksisting menghadapi keterbatasan dalam memenuhi kebutuhan *bandwidth* dan latensi untuk skenario *Massive Machine Type Communications* (mMTC). Penelitian ini bertujuan untuk merancang dan mensimulasikan jaringan 5G *New Radio* (NR) arsitektur *Standalone* (SA) pada frekuensi 700 MHz guna mendukung ekosistem industri tersebut. Perencanaan jaringan dilakukan menggunakan perangkat lunak Atoll dengan menerapkan model propagasi *Urban Macro* (UMa) standar 3GPP TR 38.901. Simulasi mencakup analisis cakupan (*coverage*) dan kapasitas (*capacity*) berdasarkan data sebaran 17.094 sensor mesin produksi. Hasil optimasi simulasi menunjukkan bahwa jaringan mampu menjangkau 100% area Kawasan Industri Rancaekek dengan kualitas sinyal kategori *Excellent*. Rata-rata nilai *Synchronization Signal Reference Signal Received Power* (SS-RSRP) diperoleh sebesar -49,48 dBm dan *Signal to Interference plus Noise Ratio* (SS-SINR) sebesar 28,6 dB. Dari sisi kapasitas, jaringan menghasilkan *throughput uplink* sebesar 20,94 Mbps dan *downlink* sebesar 19,05 Mbps. Kapasitas ini berhasil melampaui kebutuhan trafik sensor saat ini sebesar 16,41 Mbps serta memenuhi proyeksi kebutuhan lima tahun ke depan sebesar 18,12 Mbps. Berdasarkan parameter *Key Performance Indicator* (KPI) 5G, perancangan ini dinilai layak untuk diimplementasikan guna meningkatkan efisiensi operasional industri.

Kata Kunci: 5G NR, 700 MHz, Atoll, *Massive Machine Type Communications* (mMTC), Rancaekek, *Smart Factory*.

ABSTRACT

The implementation of the Smart Factory concept in the Rancaekek Industrial Estate requires a telecommunication infrastructure capable of supporting massive connectivity for thousands of Internet of Things (IoT) devices. However, existing cellular networks face limitations in meeting bandwidth and latency requirements for Massive Machine Type Communications (mMTC) scenarios. This study aims to design and simulate a 5G New Radio (NR) Standalone (SA) network at a frequency of 700 MHz to support the industrial ecosystem. Network planning was conducted using Atoll software by applying the Urban Macro (UMa) propagation model according to 3GPP TR 38.901 standards. The simulation included coverage and capacity analysis based on the distribution data of 17,094 production machine sensors. Optimization simulation results showed that the network successfully covered 100% of the Rancaekek Industrial Estate area with Excellent signal quality categories. The average Synchronization Signal Reference Signal Received Power (SS-RSRP) value was -49.48 dBm, and the Signal to Interference plus Noise Ratio (SS-SINR) was 28.6 dB. In terms of capacity, the network generated an uplink throughput of 20.94 Mbps and a downlink throughput of 19.05 Mbps. This capacity successfully exceeded the current sensor traffic requirement of 16.41 Mbps and met the five-year projected requirement of 18.12 Mbps. Based on 5G Key Performance Indicators (KPI), this design is considered feasible for implementation to enhance industrial operational efficiency.

Keywords: *5G NR, 700 MHz, Atoll, Massive Machine Type Communications (mMTC), Rancaekek, Smart Factory.*