RINGKASAN

ANALISIS KINERJA ARSITEKTUR *EDGE COMPUTING* UNTUK REDUKSI LALU LINTAS DATA PADA SISTEM *MONITORING* ENERGI BERBASIS IOT

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Laporan Tugas Akhir ini membahas dan menganalisis efektivitas penerapan arsitektur *Edge Computing* dalam mereduksi lalu lintas data pada sistem monitoring energi berbasis *Internet of Things* (IoT). Penelitian ini berfokus pada perangkat *Power Meter* yang terintegrasi dengan modul ESP32 untuk mengirimkan data konsumsi energi secara periodik melalui protokol MQTT menuju *cloud* server. Penelitian ini dilakukan sebagai salah satu alternatif solusi dalam mendukung rencana pengembangan sistem monitoring energi gedung PT. Telkom Indonesia.

Seiring meningkatnya penerapan IoT, penggunaan arsitektur *Cloud-Centric* yang mengirimkan seluruh data mentah ke server pusat berpotensi menimbulkan permasalahan skalabilitas akibat tingginya lalu lintas data dan keterbatasan *bandwidth*. Oleh karena itu, diterapkan arsitektur *Edge Computing*, di mana data diproses terlebih dahulu pada modul ESP32 sebelum dikirimkan ke server pusat.

Metode penelitian dilakukan melalui eksperimen langsung dengan membandingkan dua arsitektur, yaitu *Cloud-Centric* dan *Edge Computing*. Pengujian dilakukan menggunakan *Wireshark* dan perangkat lunak terminal untuk mengukur parameter total volume data dan *bandwidth* rata-rata. Hasil pengujian menunjukkan bahwa pada arsitektur *Cloud-Centric* rata-rata volume data yang dikirimkan sebesar 4.742.168 *bytes* dengan bandwidth 410 bit/s, sedangkan pada arsitektur *Edge Computing* sebesar 2.014.625 *bytes* dengan *bandwidth* 167 bit/s. Penerapan *Edge Computing* mampu mereduksi volume data sebesar sekitar 57% dan menurunkan kebutuhan *bandwidth* hingga sekitar 59%.

Hasil penelitian ini menunjukkan bahwa penerapan arsitektur *Edge Computing* mampu meningkatkan efisiensi komunikasi data serta mendukung skalabilitas sistem monitoring energi berbasis IoT. Temuan ini diharapkan dapat menjadi acuan dalam perencanaan dan implementasi sistem monitoring energi berbasis multi-perangkat yang lebih efisien dan berkelanjutan di masa depan.

Kata Kunci : *Edge Computing*, *Internet of Things*, MQTT, Volume Data, *Bandwidth*, Monitoring Energi

SUMMARY

PERFORMANCE ANALYSIS OF EDGE COMPUTING ARCHITECTURE FOR DATA TRAFFIC REDUCTION IN IOT-BASED ENERGY MONITORING SYSTEM

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This final project report discusses and analyzes the effectiveness of implementing Edge Computing architecture in reducing data traffic in an Internet of Things (IoT)-based energy monitoring system. This research focuses on Power Meter devices integrated with ESP32 modules that periodically transmit energy consumption data to a cloud server using the MQTT protocol. The study was conducted as an alternative solution to support the development plan of PT. Telkom Indonesia's building energy monitoring system.

Along with the increasing adoption of IoT, the use of Cloud-Centric architecture, in which all raw data are transmitted directly to the central server, may lead to scalability issues due to high data traffic and limited bandwidth. Therefore, an Edge Computing architecture is applied, where data are processed locally on the ESP32 module before being transmitted to the central server.

The research method involves direct experimental testing by comparing two architectures, namely Cloud-Centric and Edge Computing. The experiments were conducted using Wireshark and terminal software to measure total data volume and average bandwidth parameters. The results show that in the Cloud-Centric architecture, the average transmitted data volume reached 4,742,168 bytes with a bandwidth of 410 bit/s, while in the Edge Computing architecture, the data volume decreased to 2,014,625 bytes with a bandwidth of 167 bit/s. The implementation of Edge Computing successfully reduced data volume by approximately 57% and bandwidth requirements by about 59%.

These results indicate that the application of Edge Computing significantly improves communication efficiency and supports the scalability of IoT-based energy monitoring systems. This study is expected to serve as a quantitative reference for planning and implementing more efficient and sustainable multi-device energy monitoring systems in the future.

Keywords: Edge Computing, Internet of Things, MQTT, Data Volume, Bandwidth, Energy Monitoring.