

ABSTRAK

IMPLEMENTASI DAN EVALUASI PROTOTIPE *BASE STATION PRIVATE* 4G LTE BERBASIS SRSRAN PADA USRP B210 SEBAGAI INFRASTRUKTUR AKSES INTERNET PADA *BLANK SPOT*

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Kesenjangan digital di daerah terpencil (*blank spot*) masih menjadi tantangan utama dalam pemerataan akses internet. Penelitian ini mengusulkan implementasi dan evaluasi prototipe *Base Station Private* 4G LTE menggunakan teknologi *Software-Defined Radio* (SDR) USRP B210 yang diintegrasikan dengan perangkat lunak sumber terbuka srsRAN dan Open5GS. Sistem ini dirancang untuk merelai koneksi pita lebar (*backhaul*) ke dalam bentuk pancaran sinyal seluler lokal yang terisolasi (*closed-access*). Pengujian kinerja dievaluasi secara komprehensif berdasarkan tiga sektor arsitektur jaringan: *Core Network*, *Radio Access Network* (RAN), dan *Transport & QoS*. Pada sektor *Core Network*, mekanisme autentikasi EPS-AKA mencapai tingkat keberhasilan (*Attach success rate*) 100% pada kartu SIM uji dan sukses menolak akses ilegal. Pada sektor RAN, kualitas sinyal RF menembus kategori "Sangat Baik" hingga radius 7 meter dengan nilai rata-rata RSRP > -81 dBm dan SNR > 13 dB. Pada sektor *Transport*, kapasitas *throughput* jaringan lokal mampu menembus 35,3 Mbps, sementara kecepatan relai internet global (*NAT routing*) stabil pada rata-rata 18,95 Mbps. Pengujian latensi (*Round-Trip Time*) mengungkap keberadaan fenomena *Bufferbloat* pada antarmuka OS Linux akibat ketiadaan *Active Queue Management* (AQM), meskipun transmisi murni perangkat keras pada protokol UDP terbukti bebas dari *Packet Loss* (0%) dengan tingkat *Jitter* presisi (7 ms). Penggunaan instruksi paralelisasi AVX2 SIMD terbukti sukses menjaga beban komputasi CPU tetap stabil di angka utilisasi puncak 60,8% tanpa terjadi *underflow*. Hasil eksperimental ini membuktikan bahwa prototipe *Base Station* seluler berbasis SDR sangat fungsional dan layak direalisasikan sebagai alternatif infrastruktur akses internet yang hemat biaya di area *blank spot*.

Kata kunci: 4G LTE, *Base Station*, *Software-Defined Radio*, srsRAN, USRP B210, *Blank Spot*, *Quality of Service*.

ABSTRACT

IMPLEMENTATION AND EVALUATION OF A PRIVATE 4G LTE BASE STATION PROTOTYPE BASED ON SRSRAN ON USRP B210 AS INTERNET ACCESS INFRASTRUCTURE IN BLANK SPOT

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The digital divide in remote areas (blank spots) remains a major challenge for equitable internet access. This study proposes the implementation and evaluation of a Private 4G LTE Base Station prototype utilizing USRP B210 Software-Defined Radio (SDR) technology integrated with open-source software, srsRAN and Open5GS. The system is designed to relay a broadband backhaul connection into a localized, isolated cellular signal (closed-access). The performance was comprehensively evaluated across three main network architecture sectors: Core Network, Radio Access Network (RAN), and Transport & QoS. In the Core Network sector, the EPS-AKA authentication mechanism achieved a 100% attach success rate on test SIM cards while successfully rejecting unauthorized access. In the RAN sector, the RF signal quality achieved an "Excellent" category up to a 7-meter radius, with an average RSRP > -81 dBm and SNR > 13 dB. In the Transport sector, the local network throughput capacity reached 35.3 Mbps, while the global internet relay speed (NAT routing) was stable at an average of 18.95 Mbps. Round-Trip Time (RTT) latency testing revealed the occurrence of Bufferbloat at the Linux OS interface due to the absence of Active Queue Management (AQM), although pure hardware transmission on the UDP protocol was proven free of Packet Loss (0%) with highly precise Jitter (7 ms). The utilization of AVX2 SIMD parallelization instructions successfully maintained the CPU computational Load stably at a peak utilization of 60.8% without underflow. These experimental results prove that this SDR-based cellular Base Station prototype is highly functional and viable as a cost-effective internet access infrastructure alternative in blank spot areas.

Keywords: 4G LTE, Base Station, Software-Defined Radio, srsRAN, USRP B210, Blank Spot, Quality of Service.