Implementation of Parallel Processing in the L1 Controller Software for the Indigenous 5G Testbed

PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

This is to certify that this thesis (or project report) titled ***"Implementation of Parallel Processing in the L1 Controller Software for the Indigenous 5G Testbed"*** submitted by **ANSHUMAN MISHRA** to the Indian Institute of Technology Madras, for the award of the degree of **Master of Technology** is a bona fide record of the research work done by him under my supervision. The contents of this thesis (or project report), in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma..

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Abstract

5G is designed to cater to a variety of use cases and function optimally in different deployment scenarios. Even though initial setups have been done at several places, this technology is still evolving as new 3GPP releases are being published every now and then to add more stringent conditions to be met. One such use case is the URLLC (Ultra Reliable Low Latency Communications) which aims at minimizing the latency i.e faster data transmission. One way of achieving the URLLC is through faster data processing which can be achieved by making use of the multi core abilities of machines.

This work focuses on the L1 Controller Software developed at the Indigenous 5G Testbed and on how to make it run in as less time as possible by using various multithreading techniques. The L1 controller is an integral part of the NR gNodeB (gNB). It acts as an interface between the higher layers and the L1 (Physical) layer modules in the TX and RX hardware chain. This software is run on a multi core processor which gives us the freedom to use all these cores in parallel and try to reduce the compilation time of the code. It is done by using the "Pthreads" library in C which allows various threading related operations like thread creation, affinity setting etc. This report discusses various approaches used to optimize the code and tables how much time it took for each technique to compile.

It is found that although multithreading allows us to leverage the ability of parallel processing, the data has to be big enough in this case to dominate the possible overheads caused due to threading operations. Else, the entire function can be loaded on a single thread and made to run on a single core by setting affinity. This method has given about 3 to 4 fold improvement in speed in case of both downlink and uplink. While we had aimed at running multiple functions in parallel threads, the best timing came in the single thread single core case. While this result does not confirm the superiority of multithreading over uni threading, the prime goal of running the program faster than before has been achieved.

Regarding Project Details

This work performed at the Indigenous 5G Testbed at IIT Madras is confidential. The original document with complete details of the project is with Dr. Radhakrishna Ganti and can be made available on request.