NOVEL RESOURCE ALLOCATION TECHNIQUE FOR DEMAND AWARE 5G EDGE CLOUD DIMENSIONING

Yogendrarajah Sivanujan

199422B

Master of Science

Department of Electronics and Telecommunication Engineering
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University of Moratuwa
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DECLARATION

I declare that this is my own work and this Dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text. I retain the right to use this content in whole or part in future works (such as articles or books).

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The supervisors should certify the Dissertation with the following declaration.

The above candidate has carried out research for the Master of Science Dissertation under our supervision. We confirm that the declaration made above by the student is true and correct.

Name of Supervisor: Dr. Abhaya Sumanasena

Signature of the Supervisor: Date: 16/03/2025

Name of Supervisor: Dr. Kasun Hemachandra

Signature of the Supervisor: Date: 17/03/2025

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ABSTRACT

The rapid proliferation of 5G networks has led to increased demand for efficient resource allocation at the edge cloud to support latency-sensitive and compute-intensive applications. This thesis presents an optimal resource allocation framework for 5G edge cloud environments, leveraging a closed-loop architecture that integrates demand prediction, intelligent scheduling, and load balancing. The proposed framework employs machine learning-based traffic prediction models, such as Prophet, to forecast real-time demand and optimize resource provisioning dynamically. The framework consists of key components, including a central cloud resource orchestrator, edge cloud nodes, a traffic prediction module, and a resource orchestrator for cluster-wide task scheduling and load balancing. A feedback mechanism ensures continuous updates on resource utilization, enabling adaptive scaling and efficient workload distribution. Additionally, an optimization engine is incorporated to balance energy efficiency and privacy constraints while maintaining service quality. This research is implemented and evaluated using CloudSim Plus, a simulation framework for cloud computing environments and NS3, a discrete-event network simulator for internet systems. The effectiveness of the proposed approach is assessed based on metrics such as resource utilization, energy consumption, and service latency. Experimental results demonstrate that the closed-loop framework enhances the adaptability of 5G edge clouds, reducing underutilization and overprovisioning while improving overall system efficiency. The findings of this study contribute to the advancement of intelligent resource management in 5G edge computing, paving the way for scalable and autonomous cloud-native network operations. Future work may explore the integration of reinforcement learning-based optimization techniques to further enhance decision-making in dynamic edge cloud environments.

Keywords: Edge cloud, Resource orchestration, Complex resource optimization

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