Design of an Algorithm for Slice Handover in 5G Networks

Author: Tawanda Muzanenhamo

Supervisor: Associate Professor O.E. Falowo

Dept, Electrical Engineering University of Cape Town

1. Introduction

Next generation 5G wireless networks will consist of multiple technologies for devices to seamlessly access the network anytime and anywhere even at the cell edges. One of the key challenges in 5G networks is mobility management. Mobility management is the ability to maintain connection whist the call is being transferred from cell to another. In order to ensure seamless connectivity, 5G networks are integrated with call admission control algorithms to cater for the acceptance and handover of calls in the network.

2. Motivation

Wireless networks users are known to be more intolerant to dropped handoff calls than blocked new calls thus it is important for 5G network providers to integrate algorithms that prioritise handoff calls whilst minimising the number of blocked new calls.
The aim of this project is to design an algorithm for making handover decisions in sliced 5G networks and evaluate its performance.

3. Network Model & Implementation

The network model chosen for the purpose of this project consist of three network slices namely Enhanced Mobile Broadband (eMBB), Massive Machine Type Communication (mMTC) and ultra-Reliable Low Latency Communication (uRLLC).

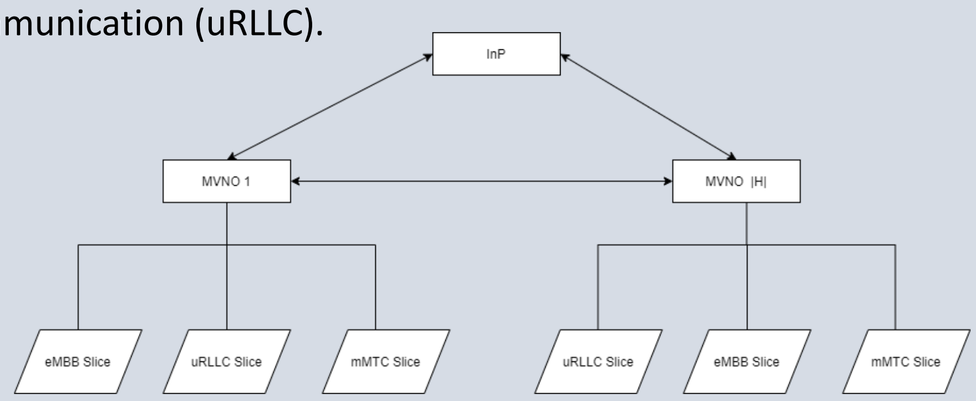


Figure 1. Network Model

Two call admission control algorithms namely intra slice and inter slice handover algorithm were implemented following Figure 1. The bidirectional arrow between MVNOs illustrates the possibility for handover.

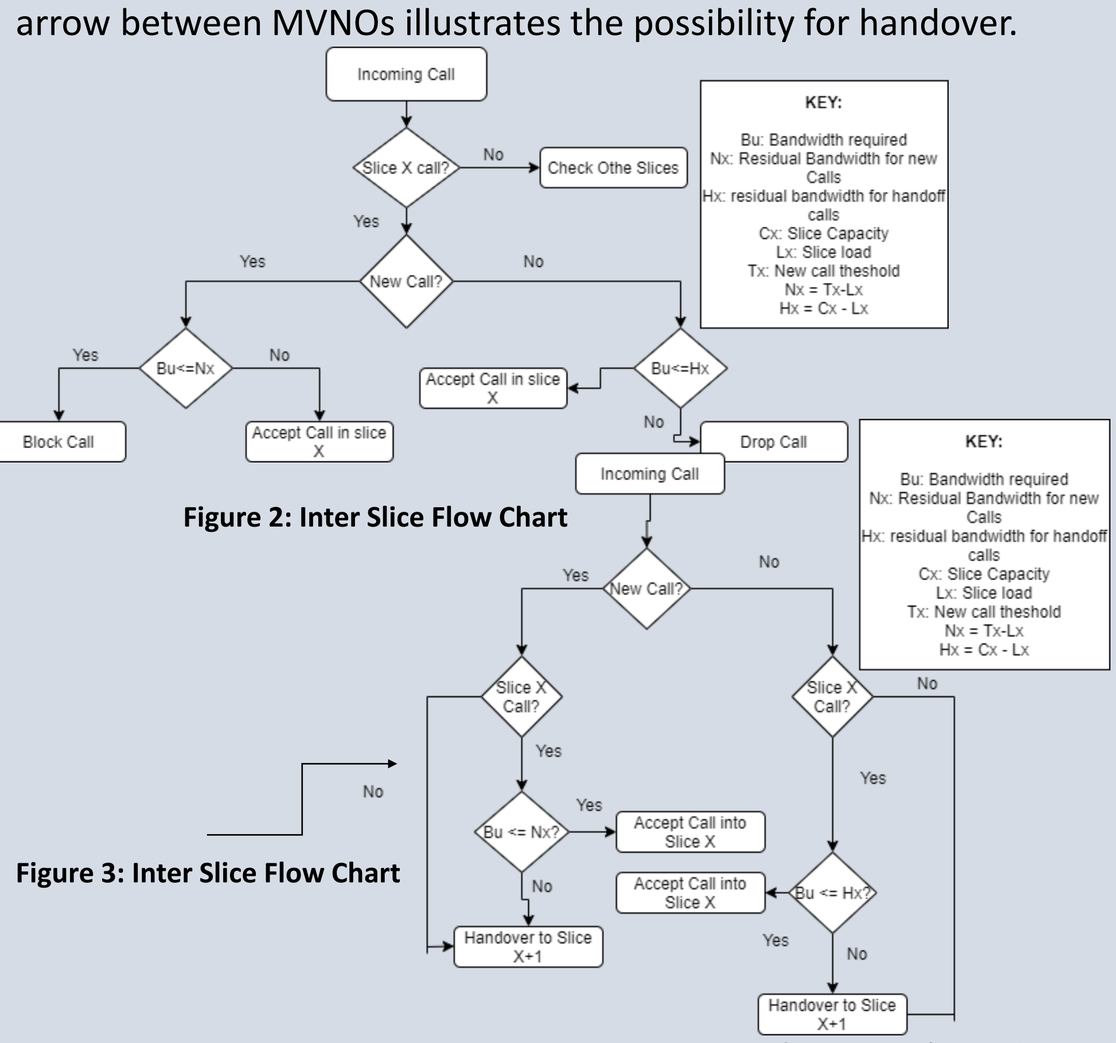


Figure 2: Inter Slice Flow Chart

Figure 3: Inter Slice Flow Chart

4. Simulations & Evaluation Metrics

The implemented algorithms were simulated in Python in order to determine their performance under different scenarios. A 2D Markov chain was used to evaluate the performance of the algorithms. The performance was determined in terms of New Call Blocking Probability (NCBP) and Handoff Call Dropping Probability (HCDP).

The following scenarios were simulated:

i. Effect of Increasing network Capacity
ii. Effect of Increasing Threshold
iii. Comparative Analysis (Intra Slice vs Inter Slice)

5. Results

The Results from the simulations are illustrated in the graphs below.

❑ The Effect of Increasing Capacity

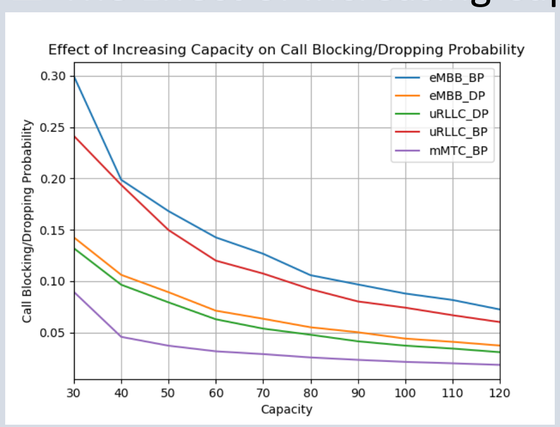


Figure 4: Effect of Capacity on Intra Slice Handover

Increasing Capacity improves QoS by decreasing call blocking and dropping probabilities.

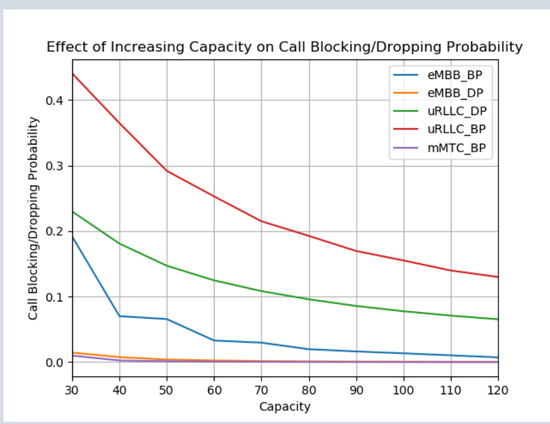


Figure 5: Effect of Capacity on Inter Slice Handover

❑ The Effect of Increasing Threshold

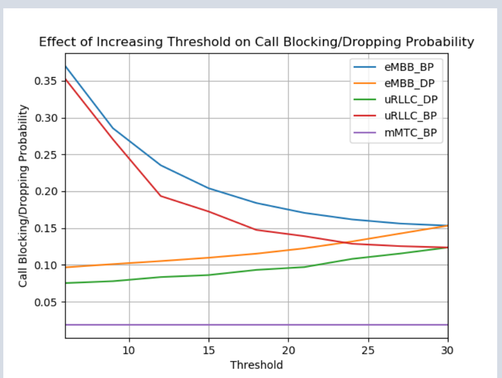


Figure 6: Effect of Threshold on Intra Slice handover

Increasing Threshold decreases new call blocking probability and increases handoff call dropping probability.

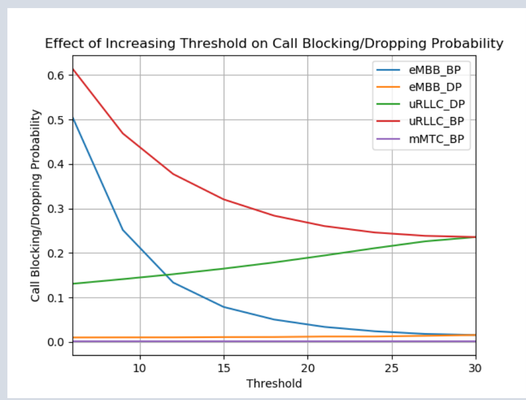
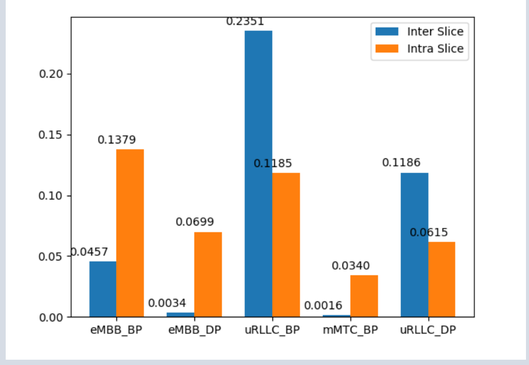


Figure 7: Effect of Threshold on Inter Slice Handover

❑ Comparative Analysis



On Average, Inter Slice handover decreases call blocking and dropping probabilities in the mMTC and eMBB slices whilst it increases the probabilities in uRLLC slice.

6. Conclusions and Recommendations

The Algorithms are sufficient to make handover decisions whilst ensuring continuous connection. Furthermore, the probability of dropping handoff calls is always less than the probability of blocking new calls because of handoff call prioritisation.

It must be noted that although inter slice handover succeeds in decreasing probabilities in mMTC and eMBB, uRLLC probabilities increase thus the algorithm should be implemented with dynamic resource allocation and more slices to mimic a real world network.

Tawanda Muzanenhamo, MZNTAW004@myuct.ac.za, 067 806 2502, University of Cape Town