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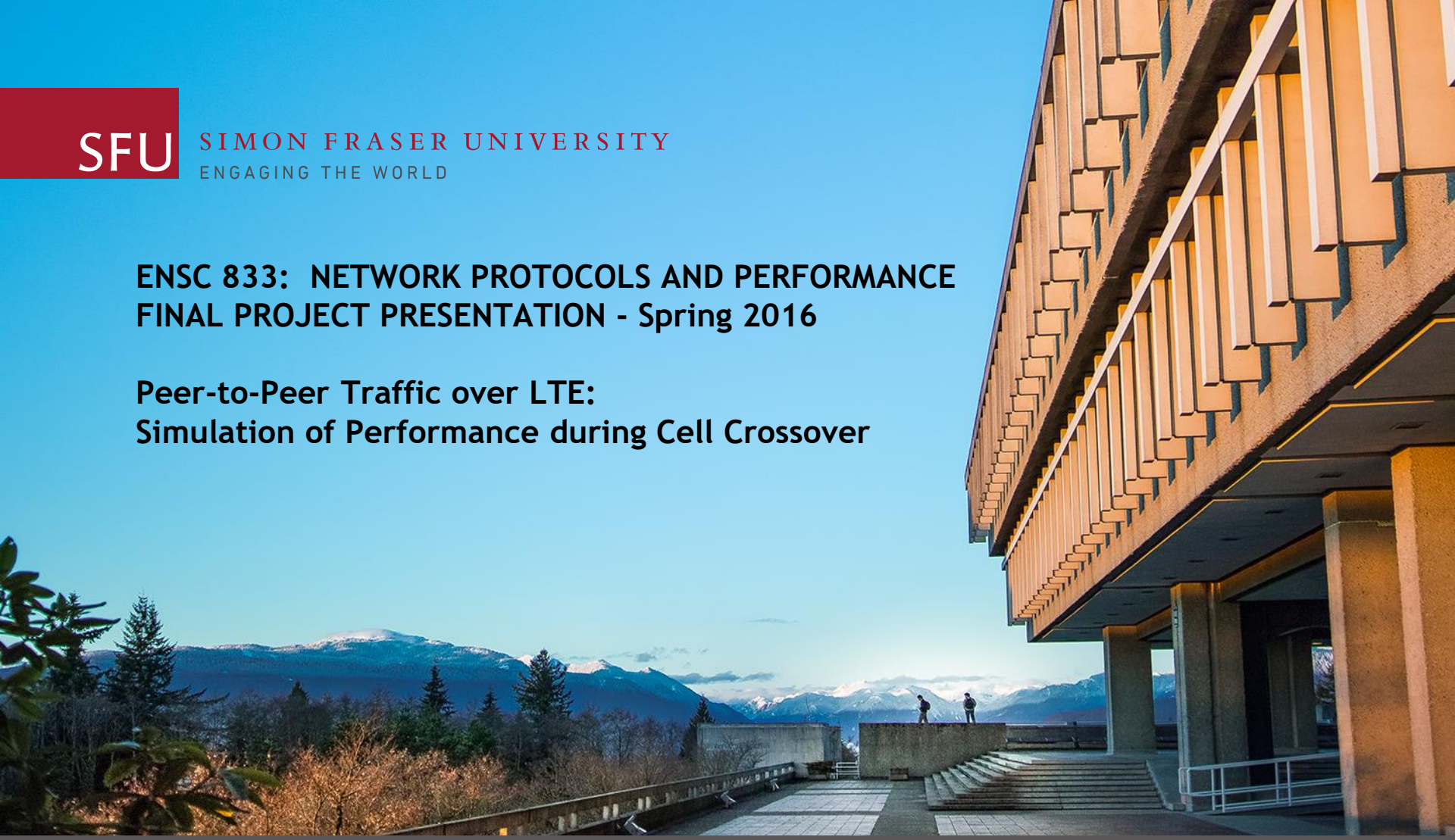
ENSC 833: NETWORK PROTOCOLS AND PERFORMANCE
FINAL PROJECT PRESENTATION - Spring 2016

Peer-to-Peer Traffic over LTE:
Simulation of Performance during Cell Crossover



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1. Introduction

Project Idea:

To model the performance effect of an LTE handover during constant-bit-rate peer-to-peer traffic.

Scope:

- Specific to peer-to-peer UDP traffic with homogeneous users.
- Two nodes send and receive packets to each other over LTE each through different base stations, then one crosses over to a different cell region.

1. Introduction

Basis of the project:

Used an existing ns3 LTE library with a handover model and created a new peer-to-peer topology and traffic pattern.

Literature Review found the following work done by others:

- [1] – Wifi Simulation in ns3.
- [2] - Custom-made ns3 LTE model built to study SINR versus distance of node from base station;
- [3] - Matlab simulator built to study performance of LTE network (at the system level);
- [4] - Lena-X2 Model of LTE in ns3 is described and used to study a single UE (node) handover across several eNBs for Received Signal Received Power/Quality.

1. Introduction

- Differences from the existing LTE handover simulation:
    - Multiple user nodes instead of just one.
    - No remote internet traffic; only peer-to-peer traffic is modeled.
    - A flow monitor class used to capture aggregate packet traffic.
    - Use of default instead of dedicated LTE bearer.

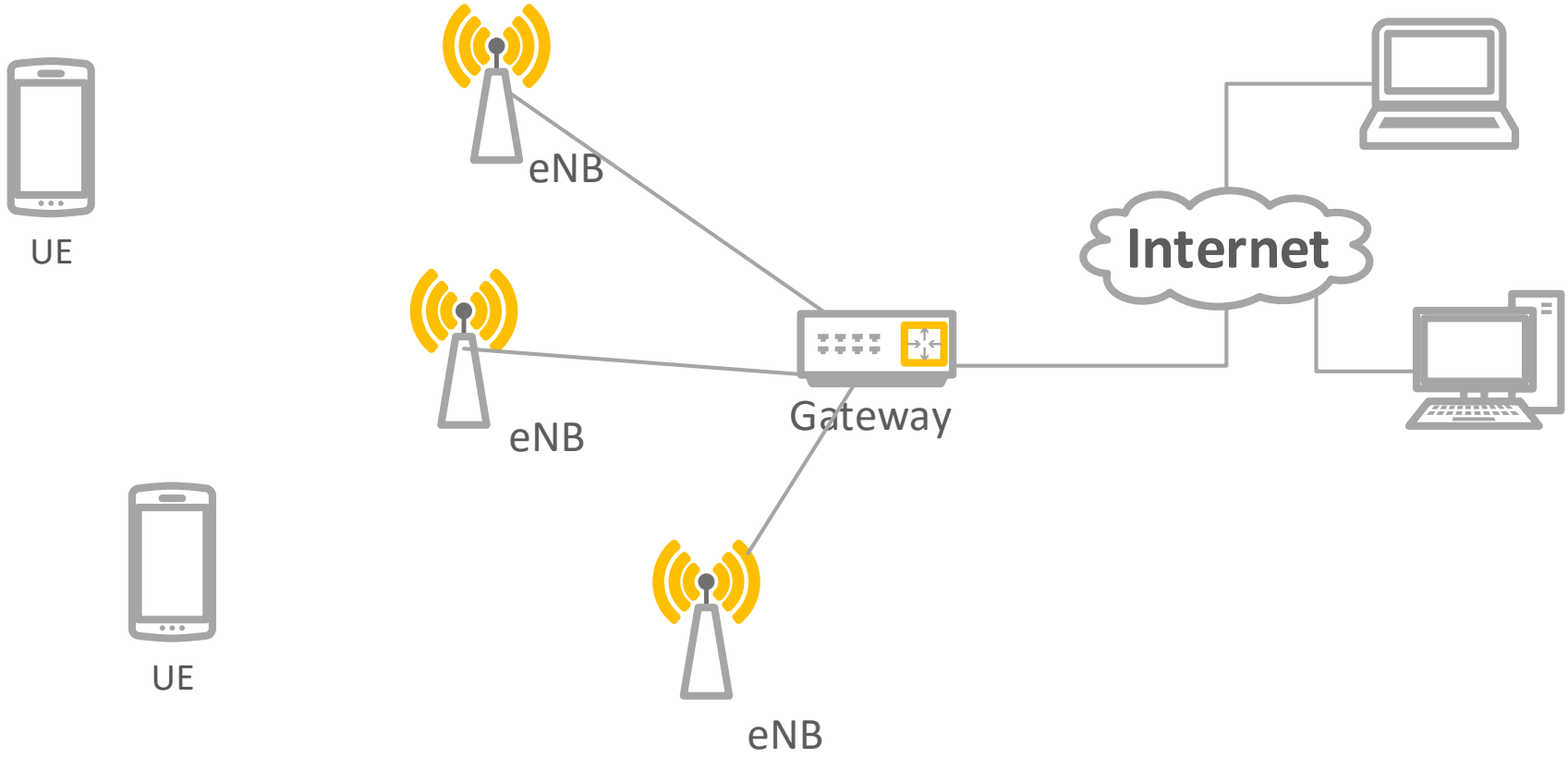
2. Implementation Details

Description of Overall Design:

- Configuration: number of users, stations, start time, simulation time, stop time and interval, uplink and downlink ports.
- Position the eNodeBs and users in space.
- Create the internet (node, stack, max transmission unit, delay, data rate.)
- Assign IP address to the Base Station.
- Create the station and user nodes.
- Add the IP stack to the user nodes.
- Assign IP addresses to the users and attach them to the first station.
- Set the attributes of the UDP daemons: Interval, MaxPackets, PacketSize.)
- Set up simulation handover.
- Monitor the flow of packets.

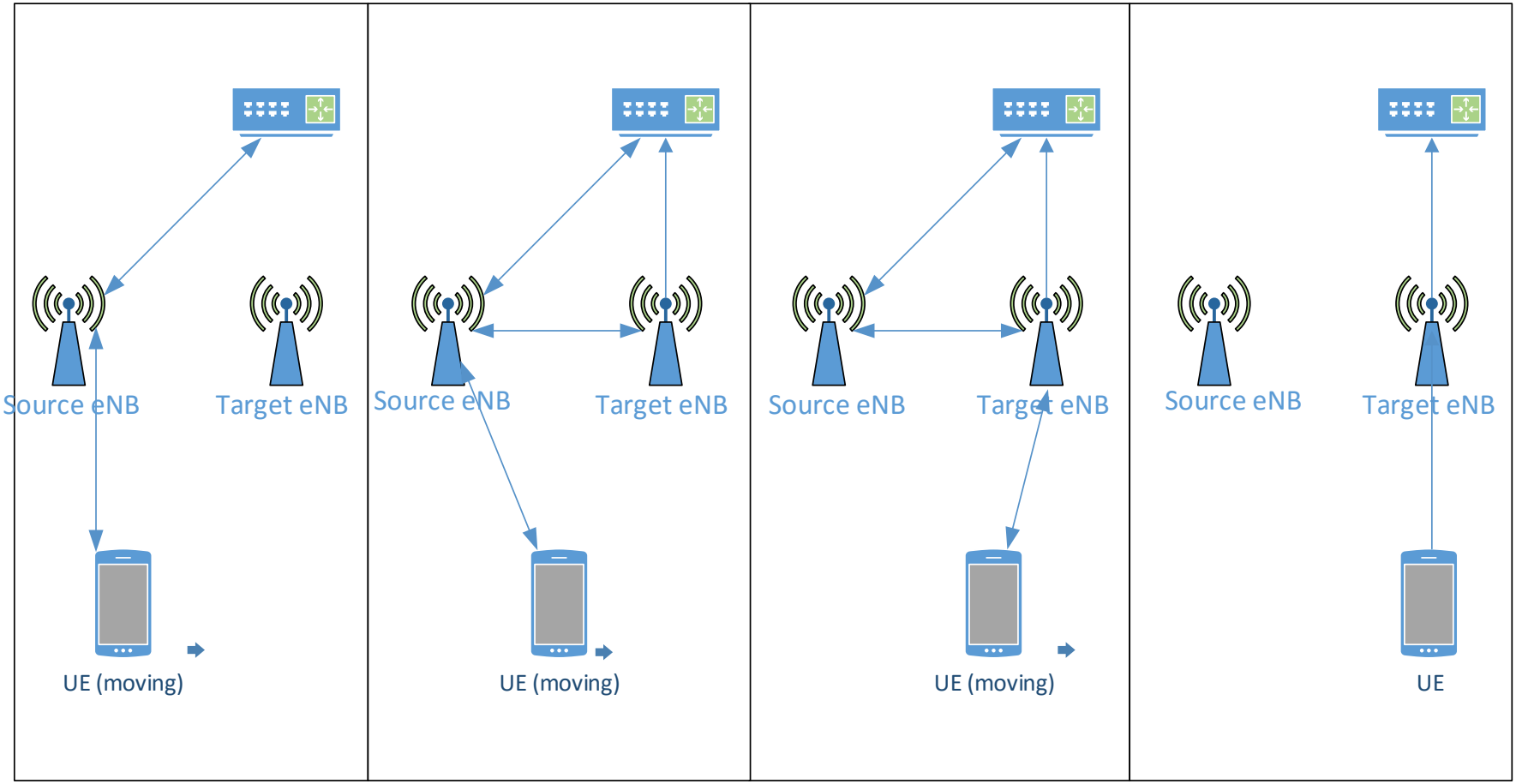
2. Implementation Details

Circuit Schematic:

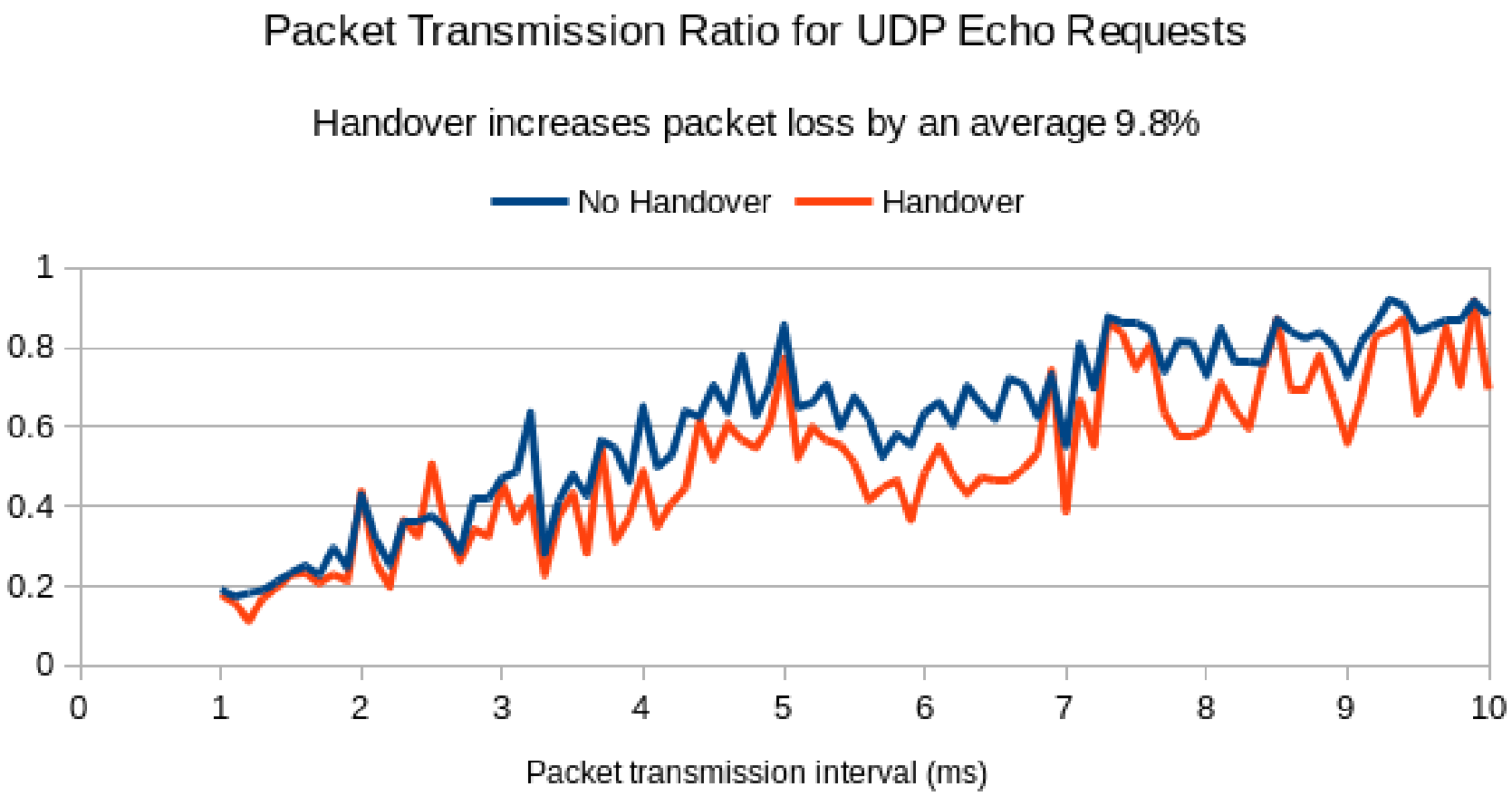


2. Implementation Details

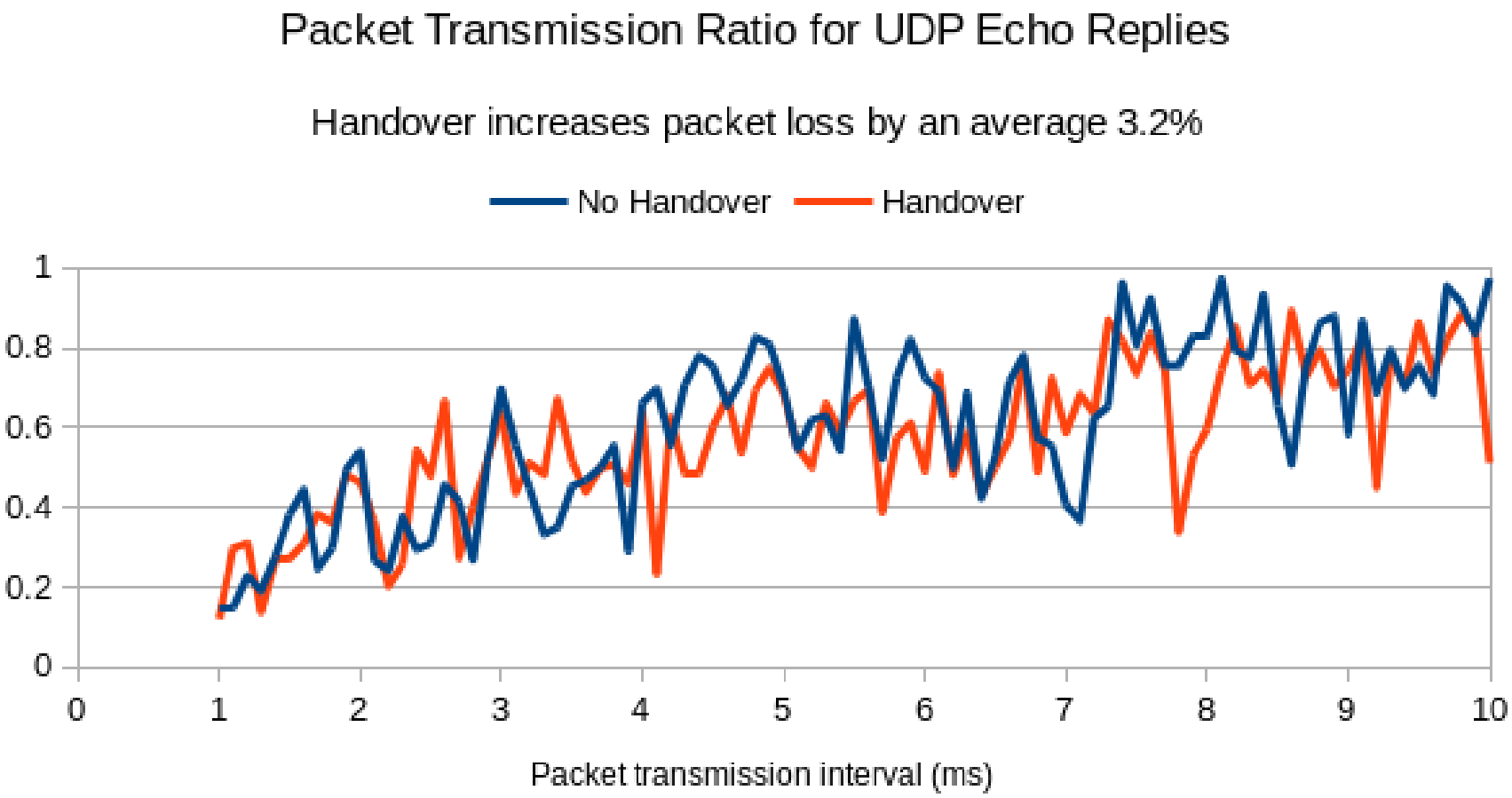
Flowchart: X2 Handover



3. Results


Packet Transmission Ratio for UDP Echo Requests
Handover increases packet loss by an average 9.8%
No Handover
Handover
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
7
8
9
10
Packet transmission interval (ms)

3. Results


Packet Transmission Ratio for UDP Echo Replies
Handover increases packet loss by an average 3.2%
No Handover
Handover
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
7
8
9
10
Packet transmission interval (ms)

3. Discussion

- LTE handover during constant-bit-rate peer-to-peer traffic increases packet loss most of the time, but the effect is mild enough that in many cases random network effects are more significant.

- Additional packet loss is seen across all tested network traffic rates, and is not strongly correlated with the network traffic.

- Packet loss depends on traffic type; replies are significantly more likely to be successfully transmitted than request.

3. Discussion

Difficulties:

- Understanding the function and operation of the existing handover simulation.
- Avoiding simulation artifacts like simultaneous packet arrivals.

Alternative Approaches:

- Use other modeling software such as Riverbed Modeler or ns2.
- Develop an alternative ns3 model of LTE.

Improvements and future work:

- Further test scalability with additional UEs and eNBs.
- Incorporate the effect of mixed internet and LTE peer-to-peer traffic.

3. Conclusions:

What we have learned from this exercise:

- As interval time is increased the packet loss decreases for both the client and the server in both handover and no-handover cases.
- The packet loss in the no-handover case is generally lower than the packet loss in the hand-over case.
- The server is less degraded by handover than the client.

4. References

[1] Jason B. Ernst, Stefan C. Kremer, Joel J. P. C. Rodrigues, “A Wi-Fi simulation model which supports channel scanning across multiple non-overlapping channels in NS3,” 2014 IEEE 28th International Conference on Advanced Information Networking and Applications, Victoria, Canada, May 2014.

[2] G. Piro, N. Baldo. M. Miozzo, “An LTE module for the ns-3 network simulator”, in Proc. of Wns3 2011 (in conjunction with SimuTOOLS 2011), March 2011, Barcelona (Spain)

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[4] N. Baldo, M. Requena, M. Miozzo, R. Kwan, "An open source model for the simulation of LTE handover scenarios and algorithms in ns-3", Proceedings of the 16th ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems, 3-8 November 2013

4. References

[5] NS-3 Version 3.24. [Network Simulation Software, Documentation and Lena-X2 Model]. (2016). Retrieved from www.nsnam.org.

[6] Ghassan A. Abed, M. Ismail, K. Jumari, "Modeling and Performance Evaluation of LTE Networks with Different TCP Variants," World Academy of Science, Engineering and Technology. International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering Vol:5, No:3, 2011.

[7] Md. Ebna Masum, Md, Jewel Babu, "End-to-End Delay Performance Evaluation for VoIP in the LTE network," Masters of Science Thesis. Dept of Telecom, Blekinge Inst. of Tech, Karlskrona, Sweden, June 2011.