

ELEC3500 TELECOMMUNICATIONS NETWORKS

Simulation Experiment I

Experiment: Introduction to OMNeT++ Modelling.

Required Reading Materials:

1. “Introduction to ELEC3500 Laboratory Work” document available on Blackboard,.
2. OMNeT++ TicToc tutorial available on <https://docs.omnetpp.org/tutorials/tictoc/>.

Objective: This laboratory session will introduce the basic use of the OMNeT++ simulation package by going through the basic TicToc tutorial. Also, you will need to make minor modifications to the code to obtain several results and different model outcomes.

Procedure:

This laboratory work will go through the seven parts of the TicToc tutorial. By going through all the steps in the tutorial, you will learn the basic steps of developing a network model and the statistics collection techniques. Follow the codes and instructions provided in the tutorial. ***Note that the TicToc code is located in the tictoc folder in the samples directory (NOT in the ELEC3500 folder).*** Extra attention should be given to the outcomes listed in the parts below.

Part 1 Getting Started

- 1.3: Understand how the modules are defined and connected.

Part 2 Running the Simulation

- 2.2: Running and visualising a simulation.
- 2.3: Debugging techniques.

Part 3 Enhancing the 2-node TicToc

- 3.1: Enhancing nodes and refining graphics.
- 3.3: Adding state variables and a packet counter.
- 3.4: Adding control parameters to control message transfer.
- 3.5: Inheriting parameters from different modules.
- 3.6: Modelling processing delay and adding time parameters.
- 3.7: Use of random numbers to vary the delay. ***Check the “results to collect” instructions below and collect those results before proceeding.***
- 3.8: Introduce the use of timers and timeout procedures.
- 3.9: Packet retransmission techniques.

Part 4 Turning it Into a Real Network

- 4.1: Adding additional nodes to increase the network size. *In this part, modify the model so that tic[0] sends data to tic[1] and tic[2]. Document the changes in your report.*
- 4.2: Introduce new channels with specific parameters.
- 4.3: Introduce two-way connections (bidirectional communications).
- 4.4: Defining message class and converting into a real network model.

Part 5 Adding Statistics Collection

- 5.1: Basic statistics collection features.
- 5.2: Further statistics collection features.
- 5.3: Statistics collection without modifying models.

Part 6 Visualizing the Results

- 6.1: Understanding output scalars and vectors.

End-to-end delay calculation: Message creation time and arrival time can be respectively obtained by using the `getCreationTime()` and `getArrivalTime()` functions of the message object (e.g., `msg->getCreationTime()` and `msg->getArrivalTime()`). The difference is the end-to-end delay.

Results to collect: In part 3.7 of the TicToc tutorial, collect the following statistics:

1. Using the default distributions, obtain the maximum, minimum and average message wait time from the simulation log of the run window.
2. Modify the distribution values to different values of your own choice and obtain the statistics in scenario 1.
3. Modify the model to use a single distribution (use only the exponential distribution with the default value) and obtain the statistics in scenario 1.

Report Submission Instruction:

You need to submit a report with a simulation section and a knowledge section.

Simulation Section: This section is marked out of 40 and should be structured as follows.

- **Introduction:** Explain the objectives of the laboratory simulation (½ A4 page maximum).
- **Simulation model and File Structure:** Referring to the model in part 4.4, describe the simulation model used as well as the file structures and their relationships (1 A4 page maximum).
- **Model Modifications:** Describe how you modified the model/code to make the changes in part 4.1 (¼ A4 page maximum).
- **Results:** Present the results obtained in part 3.7. Also, provide a brief analysis of the results by explaining the variations (6 plots maximum, each with appropriate units, axis title and legend).

Knowledge Section: This section is marked out of 60. Answer the following questions.

1. Explain the roles of the .ned, .ini and .cc files in the simulation model. [10]
2. What do the initialize() and handleMessage() functions do in the simulation code? [10]
3. Explain the role of random number generators in the network model you have used. [10]
4. Explain why the message wait time varies in part 3.7 when exponential and truncated normal distributions are used. [10]
5. Explain what information are provided by the scalar and vector result files. [10]
6. Do you think the statistical distribution functions are useful for modelling communication network? Present the reasons to support your answer. [10]

Report Submission Date:

The lab report is due on Friday at 11.59 pm of the following week after the lab is performed. Submit your report via the Assessment tab of the blackboard. Please include the university assessment cover sheet with your submission.