

MONASH UNIVERSITY
DEPARTMENT OF ELECTRICAL & COMPUTER SYSTEMS ENGINEERING
Performance of Telecommunication Networks

Experiment IV: Statistics Collection and Visualization

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Introduction

OMNeT++ has a rich set of tools for collection and visualization of simulation statistics. You can generate plots on-the-fly or you can post-process the collected data for more detailed analysis and publication. The following exercises will introduce you the OMNeT++ data collection and graphing capabilities.

Exercise 1 - Collecting Simulation Statistics

The exercise is accessible through the following Web page: <http://www.omnetpp.org/doc/tictoc-tutorial/part4.html>. Follow the steps given there and run your first simulation experiment. Afterwards answer the questions given in the following section.

Questions

1. What is the difference between a vector file and a scalar file?
2. When you re-run a simulation model, does OMNeT++ delete the contents of an existing vector file?
3. When you re-run a simulation model, does OMNeT++ delete the contents of an existing scalar file?
4. Why are the mean hop counts reported for `tic[1]` and `tic[4]` are much lower than the rest?

Exercise 2 - Visualization of Simulation Results

The exercise is accessible through the following Web page: <http://www.omnetpp.org/doc/tictoc-tutorial/part5.html>. Follow the steps given there and run your first simulation experiment. Afterwards answer the questions given in the following section.

Questions

1. Which OMNeT++ tool is used to view the contents of a scalar file?
2. Which OMNeT++ tool is used to view the contents of a vector file?

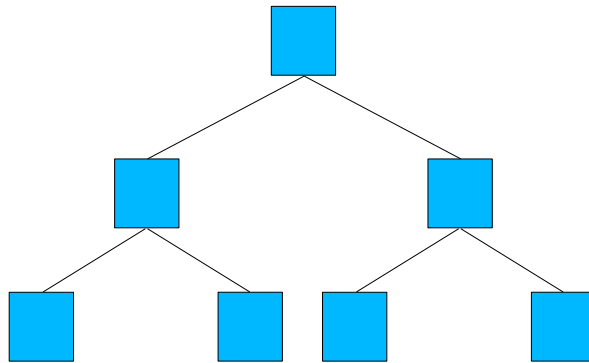


Figure 1: A centralized binary tree tictoc network.

Exercise 3 - Hop Counts and Routing Tables

I think we had enough of throwing hot potatoes around. Store-and-forward type packet-switched networks are somewhat more deterministic, let's try to model this behaviour adding a *rudimentary* routing table to each node.

The exercise and supporting files can be found on this Web page: <http://ctieware.eng.monash.edu.au/twiki/bin/view/Simulation/AddingASimpleRoutingTable>

Please examine the files `omnetpp.ini` and `txc13.cc` to see how we set the routing tables in each node and how we use them to send packets to their destinations. Afterwards go to the next exercise.

Exercise 4 - Hop Count Distributions

This exercise has two parts. In the first part you will calculate the average number of hops a packet experiences in a network of routers connected in a centralized binary tree structure. In the second part, you will use your OMNeT++ knowledge you have acquired so far to implement such a network and collect statistics on hop counts to confirm your calculations.

Part 1: Hop Count Estimation in a Centralized Binary Tree Network

A group of $2^n - 1$ routers are interconnected in a centralized binary tree, with a router at each tree node. Router i communicates with router j by sending a packet to the root of the tree (see Figure 1). The root then sends the message back down to the router j . Derive an approximate expression for the average number of hops per message for large n , assuming all router pairs are equally likely to communicate¹.

Part 2: Simulation of a Centralized Binary Tree Network

By modifying the files `omnetpp.ini`, `tictoc13.ned`, and `txc13.cc`, create the tictoc network shown in Figure 1 configured as a centralized binary tree, run the simulations and find the average hop count experienced by the packets.

¹I have taken this problem from [Tan03].

Do they match with your theoretical calculations? Show the results to your laboratory supervisor.

References

[Tan03] A. S. Tanenbaum. *Computer Networks*. Prentice Hall, 4th edition, 2003.