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Performance of Telecommunication Networks

Experiment III: 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/omnetpp/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/omnetpp/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?

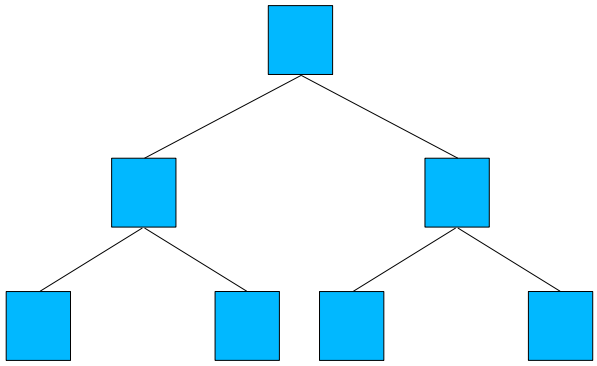

Figure 1: A centralized binary tree tictoc network.

Exercise 3 - Hop Counts and Routing Tables

I think we had enough of throwing hot potatos 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://www.ecse.monash.edu.au/twiki/bin/view/InFocus/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 communicate[1].

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.

[1] I 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, 4^{th} edition, 2003.