

TLT-2756 Ad Hoc Networks

ns-2 assignment

General

The objective of this assignment is to get familiar with the network simulator tool (ns-2) and mobile wireless network environment. This study about ad hoc wireless network will be carried out by simulations using the ns-2 tool.

These simulations will be run using Sun workstations of the Birdland (Lintula). The results of the work will be reported in writing.

In this document there are first some are conceptual definitions, instructions for simulations, reporting, grading and returning the report. In the end of this document there are some facts related to implementation details and tips for those who find the required scripting problematic.

Using ns-2

"Ns is a discrete event simulator targeted at networking research. Ns provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks." (<http://www.isi.edu/nsnam/ns>, 18.6.2004)

ns-2 is an interpreter of OTcl language, which includes objects for simulating networks. Those objects are implemented using C++, but OTcl is an interface that can be used for calling methods of the objects.

Before starting this exercise it is absolutely essential for you to get acquainted with the excellent tutorial by Marc Greis. (<http://www.isi.edu/nsnam/ns/tutorial/>). Hence it is presumed in these instructions that **students know the basic terms related to ns-2**, such as creating nodes and links, and how to use protocol and software agents to create traffic in the network.

The network to be simulated



The network topology, transmission and application agents

In the picture every circle represents a wireless mobile node. The network consists of TCP source node (n0) and destination node (n1) over an area size of 500m x 500m.

Node (n0) uses Agent/TCP/Reno as the sending TCP agent and FTP traffic source. Node (n1) is the receivers of FTP transfers, and it uses Agent/TCPSink as its TCP-agent for the connection establishment.

The routing protocol used for the simulation scenario is ad hoc routing protocol Destination Sequenced Distance Vector (DSDV) and IEEE 802.11 MAC protocol.

The targets of the simulation

In this simulation you will study, the three different wireless network scenario;

1. TCP connection over two static nodes network.

The ns-2 script file *2node_script.tcl* (<http://www.cs.tut.fi/kurssit/TLT-2756/assign.html>) for this wireless network is provided. This creates the topology described earlier, runs the simulation for 150 seconds and shows the TCP window size in two static nodes scenario with DSDV routing protocol.

Run the script and analyze the output graph for the given scenario.

2. TCP connection over 2-nodes (1 mobile and 1 static) network.

Use the given script file and change the state of the node (n1) from static to mobile for this second scenario. At time 10 s, node (n1) starts moving towards the point (45, 285) at a speed 5 m/s. The syntax of movement command;

\$ns at <time> "\$<node> setdest <location> <speed>

Where the first number is the time, the second is the node number, then comes the origin and destination locations, and finally is given the speed.

Analyze the output graph for the given scenario.

3. TCP connection over 3-nodes (2 mobile and 1 static) network.

Use the given script file, add the static node (n2) and change the state of the nodes (n0 and n1) from static to mobile for this third scenario.

At time 10 s, node (n1) starts moving towards the point (45, 285) at a speed 5 m/s.

At time 25 s, node (n0) starts moving towards the point (250, 125) at a speed 7 m/s.

Analyze the output graph and plot the TCP bandwidth (Mbps) for the given scenario.

TCP Bandwidth Calculation

This experiment shows the bandwidth distribution for the above scenario. First to plot the bandwidth, we need to trace the data corresponding to the events registered at the network into a file.

The bandwidth graph can be plot using e.g. the xgraph-program, gnu plot, or you can import the values into Excel or Matlab from the trace file (create one for bw calculation) and use tools to draw the graph.

Instructions for scripting

Create a trace file and the procedure for calculating bandwidth. The general form of the procedure for bandwidth calculation in tcl programming is

```
proc <procedure_name> {} {  
  global <sink> <variable_for_trace_file>  
  
  # Bytes received by the traffic sinks  
  set bw [$sink set bytes_  
  
  # calculates the bandwidth (in MBit/s) and writes it to the file  
  puts $<variable_for_trace_file> "$now [expr $bw/$time*8/1000000]"  
}
```

Using ns-2 and nam (network animator)

from ssh Secure shell in Windows

Use nam to experiment with the following example script *2node_script.tcl* (<http://www.cs.tut.fi/kurssit/TLT-2756/assign.html>)

PATH settings for Lintula's UNIX machines (viherkiuru.cs.tut.fi)

Add */share/ns2/ns2/bin/* to your PATH settings for Lintula's UNIX machines. For example, if you are using bash (ssh client), edit (or create) the *.bash_profile* file

\$ emacs .bash_profile

and add the line *export PATH=\$PATH:/share/ns2/ns2/bin/* into it.

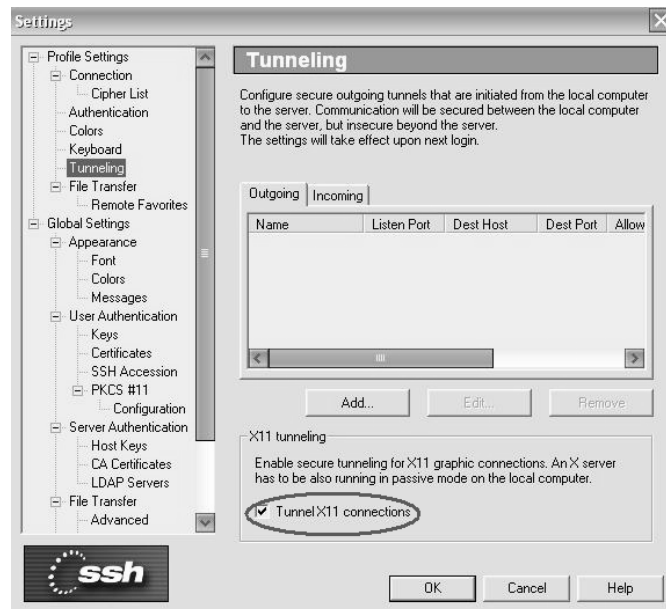
\$ <Ctrl X S>, *\$ <Ctrl X C>*, (for SAVE and EXIT emacs editor)

From this directory, now you'll find both ns nam and xgraph programs for Sun-workstations.

Viewing the xgraph and nam animator from ssh client

ssh Secure Shell Client, Edit, Settings, Tunneling

Click on the Tunnel X11 connections, *OK*



Then *ssh Secure Shell Client, File, Save Settings*

You also have to run the the Xserver in your computer.

WinAxe, Xsession (in the university Computers)

The simulation can be started from your own working directory, where you have copied the script (*2node_script.tcl*). Then run the script, ns is started with the command:

```
$ ns 2node_script.tcl
```

After the simulation, ns outputs the TCP window size xgraph and writes a trace files named *output.tr* for xgraph and *out.nam* automatically launches the nam animator, which is an X-windows based graphical software that animates the traffic based on the traces in the *out.nam* file.

Similarly, the bandwidth graph can be plot using e.g. the xgraph-program, gnu plot, or you can import the values into Excel or Matlab from the trace file (create one for bw calculation) and use tools to draw the graph.

Reporting

Write a compact (1-2 pages) description of the scenarios based on ad hoc network. In that you may use the text, images and formulas of these instructions. Next you should present the graph describing the behavior of TCP window size for different networks and the TCP bandwidth distribution for the third scenario. The results must be analyzed compared and commented. Attachments required:

- The updated Tcl-script for third scenario with the bandwidth calculation procedure.

About grading

The report will be graded using pass/fail. The following issues will be evaluated: the correctness and comparative analysis of the results, the report presentation and clarity of script.

Submission of the report

Submit the report in the wooden **box #249** (Tietotalo, 2nd floor) by 15th of November 17.00. Email **only** the final *script_file* including bandwidth calculation procedure, the name of the final script file should be *lastname_studentnumber.tcl* (*smith_12345.tcl*). The Electronic versions of the report (sent via e-mail or by other means) will not be considered.

Questions regarding the assignment please contact dipti.adhikari@tut.fi .