

Configuration Manual

MSc Research Project
MSc in Cloud Computing

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MSc Project Submission Sheet
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Configuration Manual

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1 Introduction

The software tools required to execute the project are described in this document. Additionally, this manual details how to install the necessary software step-by-step, load the code into systems and then execute the project to achieve results. This configuration manual includes step-by-step instructions to download and install the NS2 simulator and NAM. The whole manual is divided into three parts, section 1 covering information on downloading the tools and software needed for the project, section 2 detailing tools installation, and section 3 covering information on software setup & the other essential details for the implementation. For the purpose of simulation, a virtual machine in the Oracle Virtual box with the Ubuntu as the Operating System is used.

2 Downloading tools and software

2.1 Oracle Virtual Box

Oracle VirtualBox is used to create multiple virtual machines (VMs) and utilize them concurrently with the real computer. Also, this is a hosted hypervisor whose installation and execution takes place on the top of the host of the original existing main operating system. With a great user-friendly graphical user interface, the open-source Oracle Virtual Box software offers outstanding performance and a variety of functions, Li (2010). On a single physical computer, it enables users to create many operating system machines.



Figure 1: Oracle Virtual Box

2.2 Ubuntu

Ubuntu is an open-source and free operating system which is widely used on computers. Ubuntu is a Debian-based Linux distribution. It is appropriate for internet of things (IoT) gadgets, servers, workstations, and cloud computing. After carefully weighing the following factors, I chose the Ubuntu distribution (version 18.04.6) among several other Linux distributions:

- Ubuntu requires the user to provide a username and password during the UI installation. This username and password only have administrator permissions rather than full root privileges, increasing security and preventing unauthorized access to the system.
- Also as per Housani et al.(2009) among all operating systems, including Windows Vista and Mac, Ubuntu offers a number of security measures that make it one of the most secure.

We have downloaded the Ubuntu Image¹ and have then installed it over the Oracle Virtual Box.

2.3 Network Simulator 2

Using the NS2 simulator, users can have real-time control and management of the routing algorithms. The network simulator NS2 uses the events to simulate both wired and wireless networks. It is also useful for simulating wireless routing strategies and network operations. In our research, NS2 is being used to build a wireless network topology to represent how the CPEP routing algorithm can be utilized. Network protocols including UDP and TCP, traffic patterns like Telnet and Constant - Bit - Rate (CBR), and routing protocols like Ad-hoc Distance vector routing, DSDV are all simulated by the NS2 simulator. Because of its modular and adaptable configuration, NS2 has gained recognition as a reliable network simulator that can be widely used in the fields of networking and research. This can be directly downloaded and installed from the apt package in Ubuntu.

2.4 Network Animator

Nam is a Tcl/TK-based animation tool for examining packet traces from actual networks as well as network simulations. It provides numerous data inspection tools, topology layout and packet level animation. This can be directly downloaded and installed from the apt package in Ubuntu.

3 Software Tool and Package Installation

- 1 Installation of Oracle Virtual Box
2. Installation of Ubuntu OS
3. Installation of NS2 Package
4. Installation of NAM Package

3.1 Installation of Oracle Virtual Box

After downloading the Oracle Virtual box, we have to install the same from the downloaded .exe file. The steps that need to be followed are very simple and easy². Storage preferable is 40 GB and RAM 4 GB.

3.2 Installation of Ubuntu OS

After downloading the ISO image for the ubuntu OS it should be installed on the Virtual box.³

¹ <https://releases.ubuntu.com/18.04/>

² <https://data-flair.training/blogs/install-virtualbox/>

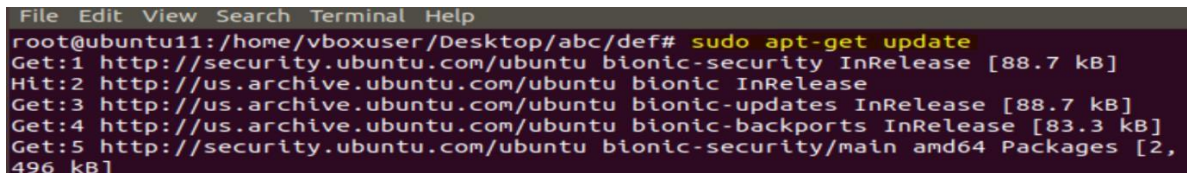
³ https://linuxhint.com/install_ubuntu_18-04_virtualbox/

3.3 Installation of NS2 Package

The Network Simulator 2 is installed using the following procedures on Ubuntu 64-bit:

Step1: The Ubuntu repositories must be updated using the following command before the NS2 package is installed:

sudo apt-get update

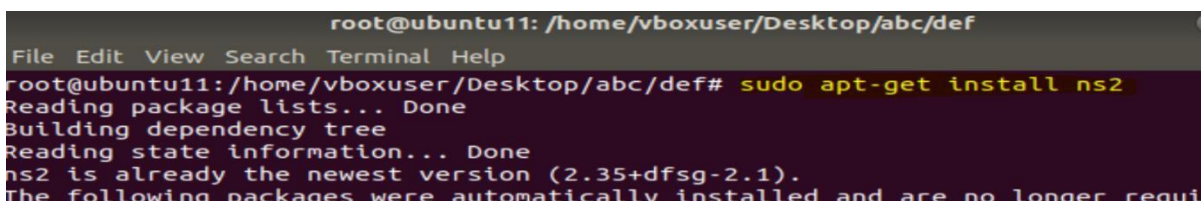


```
File Edit View Search Terminal Help
root@ubuntu11:/home/vboxuser/Desktop/abc/def# sudo apt-get update
Get:1 http://security.ubuntu.com/ubuntu bionic-security InRelease [88.7 kB]
Hit:2 http://us.archive.ubuntu.com/ubuntu bionic InRelease
Get:3 http://us.archive.ubuntu.com/ubuntu bionic-updates InRelease [88.7 kB]
Get:4 http://us.archive.ubuntu.com/ubuntu bionic-backports InRelease [83.3 kB]
Get:5 http://security.ubuntu.com/ubuntu bionic-security/main amd64 Packages [2,496 kB]
```

Figure 2 – Update Command

Step 2: The command for the installation of NS2 is shown

below – **sudo apt-get install ns2**



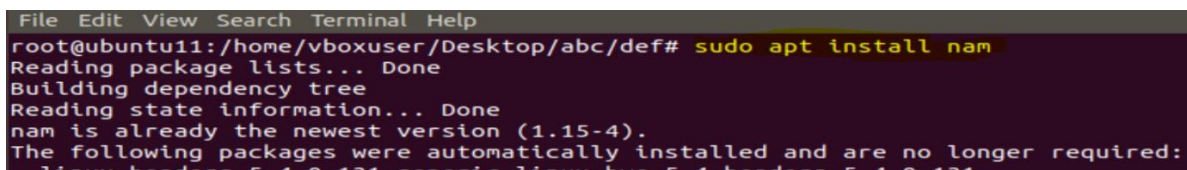
```
root@ubuntu11:/home/vboxuser/Desktop/abc/def
File Edit View Search Terminal Help
root@ubuntu11:/home/vboxuser/Desktop/abc/def# sudo apt-get install ns2
Reading package lists... Done
Building dependency tree
Reading state information... Done
ns2 is already the newest version (2.35+dfsg-2.1).
The following packages were automatically installed and are no longer required:
```

Figure 3 - NS2 Installation Command

3.4 Installation of NAM Package

For examining packet traces NAM is required to be installed. This can be done using the command below.

sudo apt install nam



```
File Edit View Search Terminal Help
root@ubuntu11:/home/vboxuser/Desktop/abc/def# sudo apt install nam
Reading package lists... Done
Building dependency tree
Reading state information... Done
nam is already the newest version (1.15-4).
The following packages were automatically installed and are no longer required:
```

Figure 4 NAM installation Command

4. Final Implementation

Now we just have to download and extract the code provided in the .zip file and have to perform the following steps.

Step 1- Download the .zip for the code and extract the files.

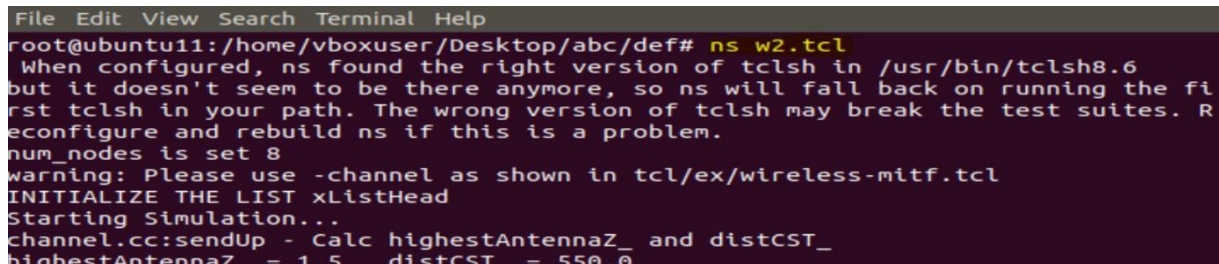
In the set of files there is a **w2.tcl** file which is the primary file. The simulation scenarios are then performed by executing this tcl file. The ns command is used to start the simulation, followed by the name of the tcl file.

Upon execution of tcl file, it determines how many nodes are included in the topology design and creates the appropriate number of wireless nodes in accordance with the configuration of the topology.

Step 2 – Execution

Upon execution of tcl file, it determines how many nodes are included in the topology design and creates the appropriate number of wireless nodes in accordance with the configuration of the topology. To execute the command used will be-

ns w2.tcl



```
File Edit View Search Terminal Help
root@ubuntu11:/home/vboxuser/Desktop/abc/def# ns w2.tcl
When configured, ns found the right version of tclsh in /usr/bin/tclsh8.6
but it doesn't seem to be there anymore, so ns will fall back on running the fi
rst tclsh in your path. The wrong version of tclsh may break the test suites. R
econfigure and rebuild ns if this is a problem.
num_nodes is set 8
warning: Please use -channel as shown in tcl/ex/wireless-mitf.tcl
INITIALIZE THE LIST xListHead
Starting Simulation...
channel.cc:sendUp - Calc highestAntennaZ_ and distCST_
highestAntennaZ_ = 1.5, distCST_ = 550.0
```

Figure 5 Execute .tcl Command

Step 3 – Network Animation

The TCL script will produce .nam file when it is executed. We can see there is a file named 002.nam in the folder. To run NAM the following command is used-

nam 002.nam

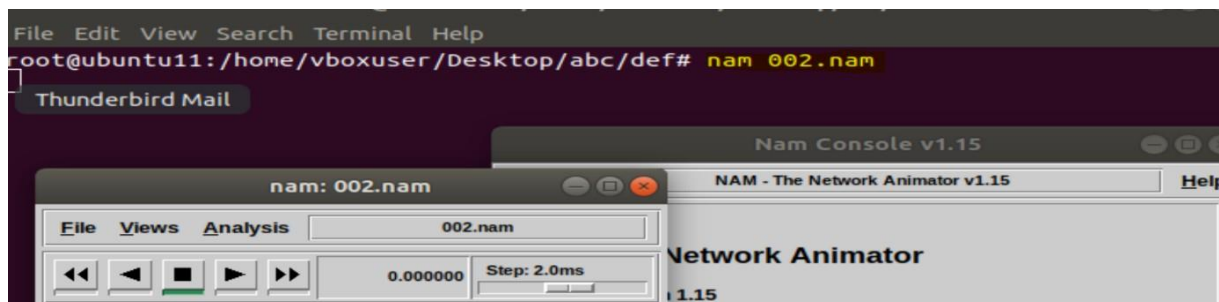


Figure 6 Open nam Command

5. Scripts for Capturing Performance Statistics

5.1 Average End-to-End Delay – When a packet leaves the source node and travels to the destination, the extra time taken by the packet is known as the average end-to-end delay. It is calculated as the difference between the packet's actual transit time and the expected transit time. An awk script is used to calculate the average end-to-end delay.

This awk script is also in the .zip provided by name e2edelay.

To get the results from this awk the command to be used is –

awk -f e2edelay.awk 002.tr

```
root@ubuntu11: /home/vboxuser/Desktop/abc/def
File Edit View Search Terminal Help
root@ubuntu11: /home/vboxuser/Desktop/abc/def# nam 002.nam
root@ubuntu11: /home/vboxuser/Desktop/abc/def# awk -f e2edelay.awk 002.tr

Average End-to-End Delay      = 37.8616 ms

root@ubuntu11: /home/vboxuser/Desktop/abc/def#
```

Figure 7- Command for Average End-to-End Delay

5.2 Throughput

The rate by which packets were transmitted from source to final destination node is used to calculate a network's throughput. An awk script is used to compute the traces and give the final results.

The name of the awk file used is throughput2.awk The command used is –

awk -f throughput2.awk 002.tr

```
File Edit View Search Terminal Help
root@ubuntu11: /home/vboxuser/Desktop/abc/def# nam 002.nam
root@ubuntu11: /home/vboxuser/Desktop/abc/def# awk -f e2edelay.awk 002.tr

Average End-to-End Delay      = 37.8616 ms

root@ubuntu11: /home/vboxuser/Desktop/abc/def# awk -f throughput2.awk 002.tr
Average Throughput[kbps] = 6164.60      StartTime=0.00 StopTime=50.09
root@ubuntu11: /home/vboxuser/Desktop/abc/def#
root@ubuntu11: /home/vboxuser/Desktop/abc/def# █
```

Figure 8 – Command for throughput

References

Li, P., 2010. Selecting and using virtualization solutions: our experiences with VMware and VirtualBox. *Journal of Computing Sciences in Colleges*, 25(3), pp.11-17.

Al Housani, B., Mutrib, B. and Jaradi, H., 2009, December. The Linux review-Ubuntu desktop edition-version 8.10. In *2009 International Conference on the Current Trends in Information Technology (CTIT)* (pp. 1-6). IEEE.