NS3 is designed to run on Linux platforms, but it does not prevent being installed in other operating systems such as Mac OS and Windows OS, which can provide users with a Linux environment. In this thesis, the installation is done in the Windows operating system using the virtualization technology WSL "Windows Subsystem for Linux," which allows users to install, manage, and use a total Linux environment without installing VirtualBox or setting up a dual-boot system. This section will cover the step-by-step installation process of NS3 on Kali Linux distribution application windows using WSL technology.

Step 1: WSL configuration on Windows 10

Windows Subsystem for Linux (WSL) is a compatibility layer for running Linux binary executables natively on Windows 10. It allows installing a Linux distribution as an application from the Windows store in which Basic Linux Commands (i.e., sudo, apt, ls, cat, nano, cp, mv) can be executed and running Bash shell scripts with different program languages such as Languages: C, C++, Python, NodeJS…

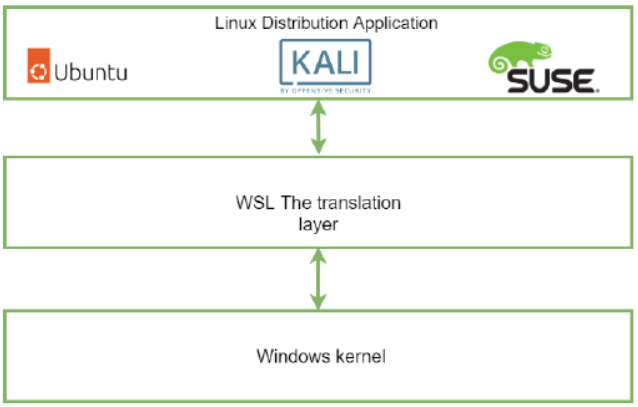

Figure A.1: WSL architecture

Figure A.1: WSL architecture

To get WSL working, we have to activate "Virtual Machine Platform" and "Windows Subsystem for Linux" feature by typing on the Windows search bar "Turn Windows features on or off".

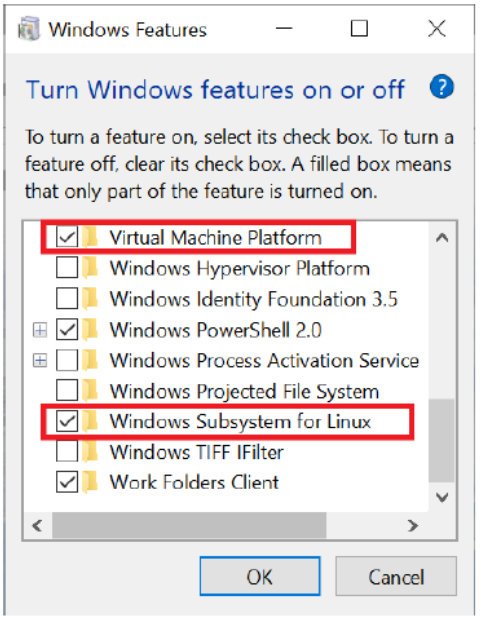

Figure A.2: Enable the "Virtual Machine Platform" and "Windows Subsystem for Linux"

It can also be done in another way through PowerShell. Just open the PowerShell terminal as administrator and type

Code snippet A.1: Enable the "Virtual Machine Platform" and "Windows Subsystem for Linux" via PowerShell terminal

```
//Enable Windows Subsystem for Linux dism.exe
/online /enable-feature ←-
    /featurename:Microsoft-WindowsSubsystem-Linux /all /norestart
```

```
//Enable Virtual Machine feature dism.exe /online /enable-feature
/featurename:VirtualMachinePlatform ←-
    /all /norestart
```

WSL is now activated. To proceed to the next step, the computer needs to restart

Step 2: Installation of Linux Distribution

Microsoft Store offers a wide variety of Linux applications like ubuntu, Suse, Kali Linux, and many others. In this thesis, Kali Linux is used.

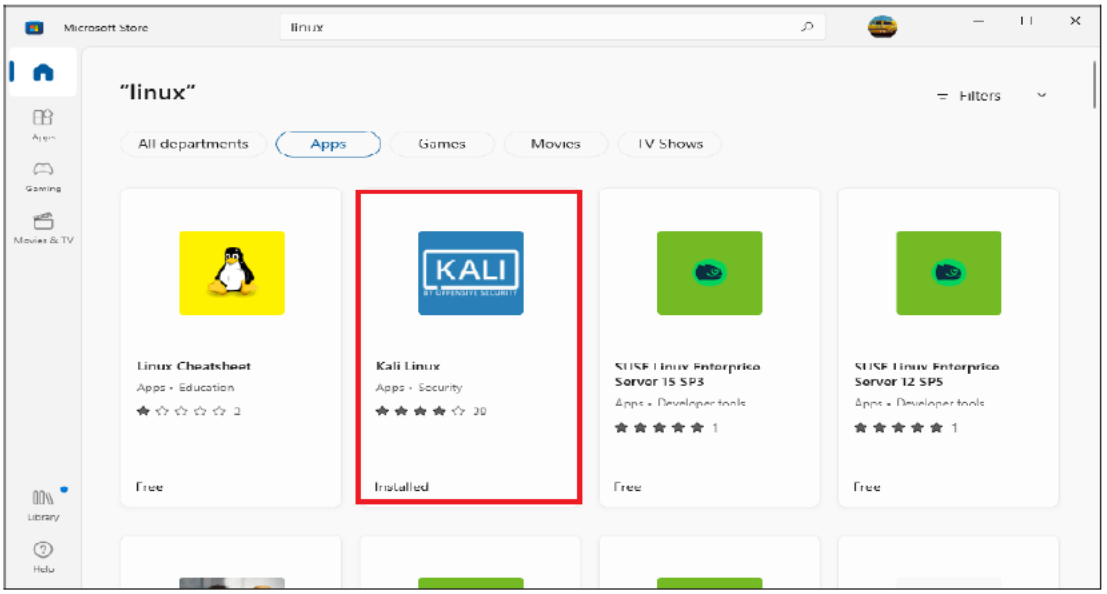

Figure A.3: Kali Linux

```
wsl -l -v
```

After the installation is finished, go back to the widows search bar and type kali Linux to set up a user account and password then we have to make sure that the distribution is working under WSL by typing the next command in PowerShell terminal. 1

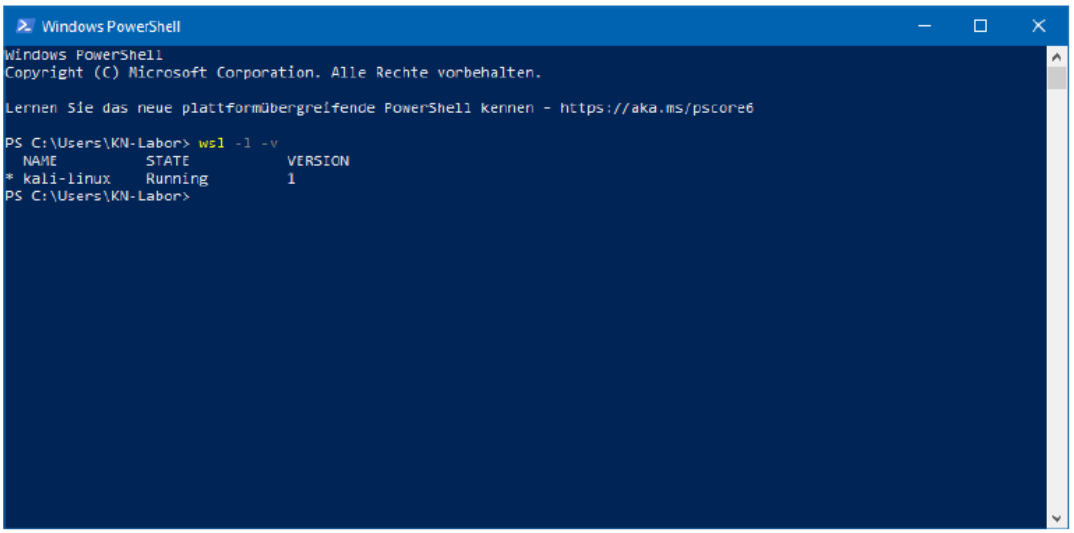

Figure A.4: Checking Kali Linux is running and the WSL

Step 3: NS3 Installation

As Kali Linux is working under the WSL technology, we need to install some packages before installing NS3. It is preferred to update and upgrade the system first.
For that, we have to get root privileges.

```
//root user in Linux sudo su
//Update and Upgrade the System sudo
apt-get update && apt-get upgrade
//Dependencies installation
    sudo apt-get install gcc g++ git mercurial cmake libc6-dev ←libc6-dev-i386
        g++-multilib gdb valgrind gsl-bin libgsl0-dev ←flex bison libfl-dev tcpdump
        wireshark sqlite3 libsqlite3-dev ←libxml2 libxml2-dev libgtk2.0-0
        libgtk2.0-dev vtun lxc ←uncrustify doxygen graphviz imagemagick texlive
        ←texlive-extra-utils texlive-latex-extra texlive-font-utils ←dvipng dia
        libboost-filesystem-dev openmpi-bin openmpi-common ←openmpi-doc
        libopenmpi-dev gnuplot
//exit from root exit
```

At this point the system is ready for downloading and installing the NS3 Simulation tool. Before downloading and installing NS3 from the official website (https://www.nsnam.org
/releases/NS3-34/), a new folder named NS3 is created under the Home directory.

```
//navigate to home directory cd ~
//create floder where NS3 simulator will be installed mkdir NS3
//naviagte to NS3 folder cd
NS3
```

the last stable version of NS3 is NS3.34 which is available for download at NS3 Releases. To download NS3 simulator we have to type this two command in Kali Linux terminal under the folder NS3 that was created.

```
//downloading NS3 installation Pack from the internet wget
https://www.nsnam.org/release/ns-allinone-3.34.tar.bz2
//extracting the files tar xvjf
ns-allinone-3.34.tar.bz2
```

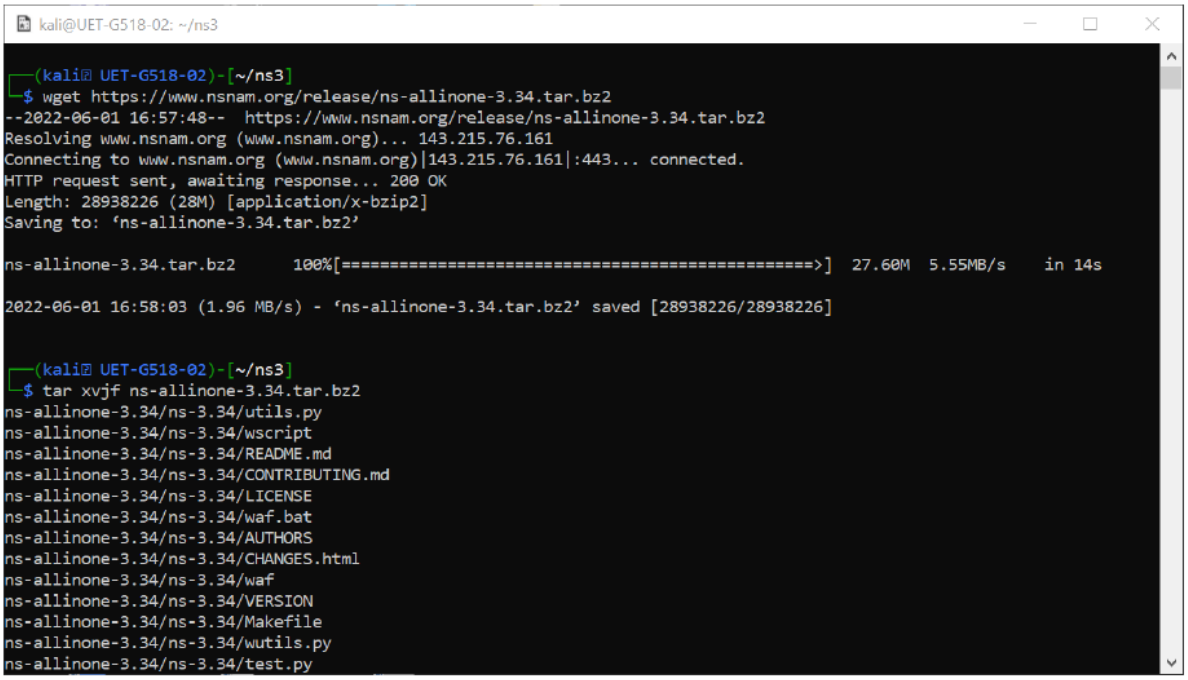

Figure A.5: Download and Extract NS3

To complete the installation we have to navigate to ns-allinone-3.34 folder by typing those commands the output should be like in figure A.6 presented.

```
//navigate to ns-allinone-3.34 cd
ns-allinone-3.34
// Build NS3 with build command
./build.py --enable-tests --enable-examples
```

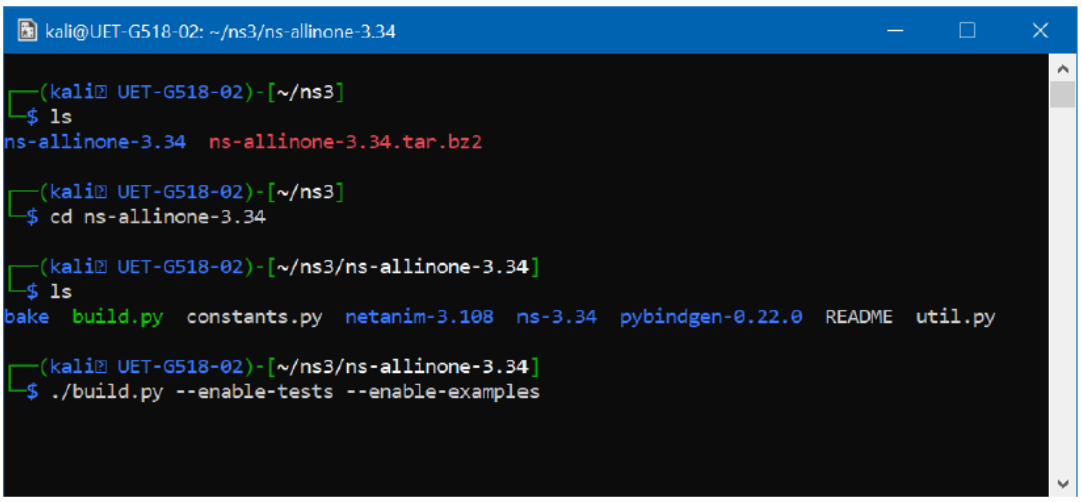

Figure A.6: compile and build NS3 simulator

The build of the whole NS3 simulators takes a several minutes (around 30 minutes). After that, the software set-up is complete. The last step is to check if the simulator is working fine by typing

```
//testing
./waf --run hello-simulator
```

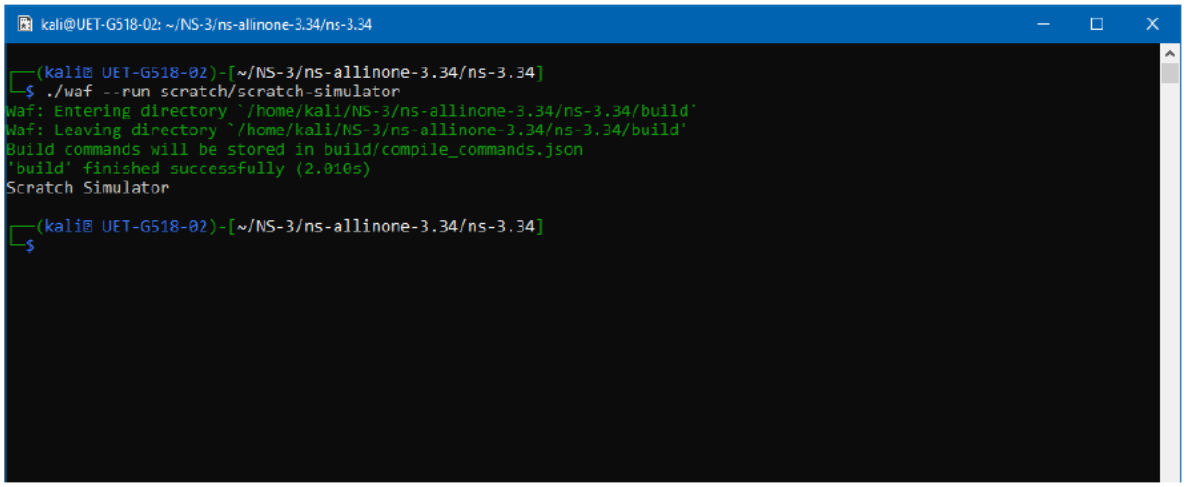

Figure A.7: Installation check

As before mentioned the script has to be created under the "scratch" folder of NS3 otherwise, it will be no possible to execute any simulation .Therefore we have to navigate from the home directory to "/NS3/ns-allinone-3.34/NS3.34/scratch" by typing this command in the Kali Linux terminal after that, we have to create a file with .cc extension.

```
//navigate to scratch folder cd
NS3/ns-allinone-3.34/NS3.34/scratch
    //crate a file with .cc extention (the name chosen in this work is ←network.cc)
touch network.cc
//open the Kali Linux internal script editor nano
network.cc
```

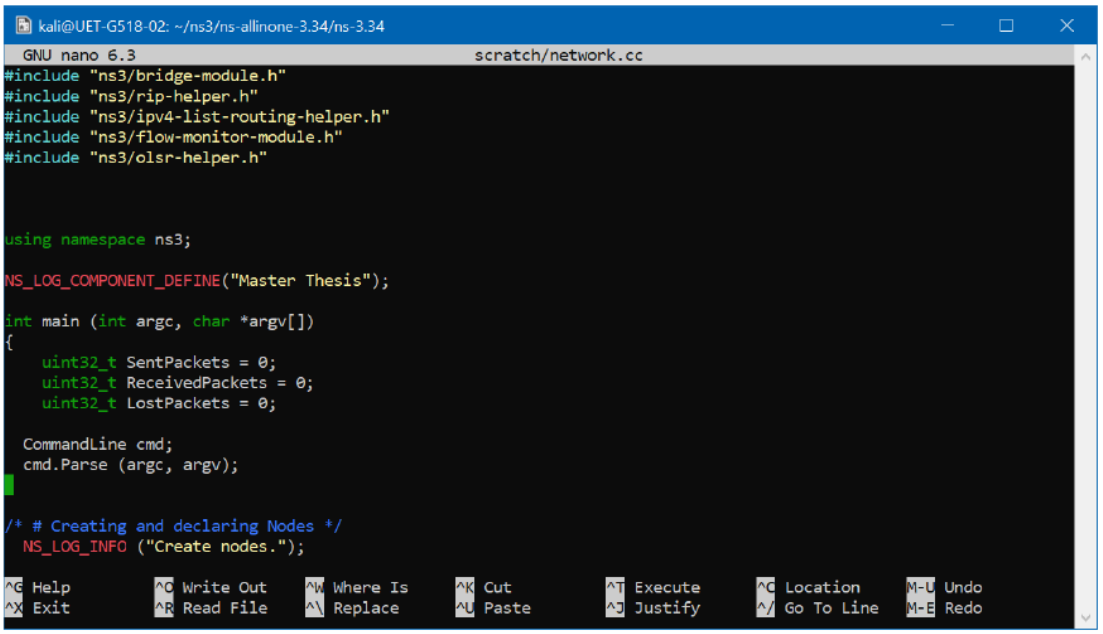

Figure A.8: Kali Linux internal script editor

```
./waf -v --run "scratch/network.cc"
```

Although we are able to write scripts directly from the Kali Linux terminal, it is not practical to do it because it is not flexible as external code editors such us Visual Studio code PyCharm and sublime text editor and many others. For executing a script in NS3 the command "waf -run scratch/filename" is used to run the simulation. Here the filename is network.cc , in which the proposed network topology is is modeled. 1