Practical No: 1

Aim: Installation of NS-3 in Linux

Steps:

1. sudo apt upgrade

```
lab2-@lab2-B250M-D2V:~$ sudo apt upgrade
[sudo] password for lab2-:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
  libjs-jquery-ui
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following packages will be upgraded:
  apt apt-utils cups-browsed cups-filters cups-filters-core-drivers
  distro-info-data gdm3 gir1.2-gdm-1.0 im-config libapt-pkg6.0 libcupsfilters1
  libfontembed1 libgdm1 libglib2.0-0 libglib2.0-bin libglib2.0-data
  libgssapi-krb5-2 libk5crypto3 libkrb5-3 libkrb5support0 libldap-2.5-0
  libldap-common libllvm15 libnss-systemd libpam-systemd libsystemd0 libudev1
  libwebp7 libwebpdemux2 libwebpmux3 linux-firmware linux-libc-dev python3-tz
  systemd systemd-oomd systemd-sysv systemd-timesyncd tzdata
  ubuntu-advantage-tools udev xserver-common xserver-xephyr xserver-xorg-core
  xserver-xorg-legacy
44 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
```

2. sudo apt update

```
lab2-@lab2-B250M-D2V:~$ sudo apt update
Hit:1 http://in.archive.ubuntu.com/ubuntu jammy InRelease
Get:2 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Get:3 http://in.archive.ubuntu.com/ubuntu jammy-updates InRelease [119 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu jammy-backports InRelease [108 kB]
Get:5 http://in.archive.ubuntu.com/ubuntu jammy-updates/universe i386 Packages [
610 kB]
Get:6 http://in.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages
[901 kB]
Fetched 1,848 kB in 3s (616 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
All packages are up to date.
lab2-@lab2-B250M-D2V:~$
```

3. sudo apt-get install g++ python3

```
lab2-@lab2-B250M-D2V:~$ sudo apt-get install g++ python3
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
g++ is already the newest version (4:11.2.0-1ubuntu1).
python3 is already the newest version (3.10.6-1~22.04).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
lab2-@lab2-B250M-D2V:~$
```

4. sudo apt-get install g++ python3python3-dev pkg-config sqlite3

```
lab2-@lab2-B250M-D2V:~$ sudo apt-get install g++ python3 python3-dev pkg-config
sqlite3
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
g++ is already the newest version (4:11.2.0-1ubuntu1).
pkg-config is already the newest version (0.29.2-1ubuntu3).
python3 is already the newest version (3.10.6-1~22.04).
python3-dev is already the newest version (3.10.6-1~22.04).
sqlite3 is already the newest version (3.37.2-2ubuntu0.1).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
lab2-@lab2-B250M-D2V:~$
```

5. sudo apt install -y qtcreator qtbase5-dev qt5-qmake cmake

```
lab2-25@lab225-B250M-D2V: ~
lab2-25@lab225-B250M-D2V:~$ sudo apt install -y qtcreator qtbase5-dev qt5-qmake cmake
[sudo] password for lab2-25:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
qtcreator is already the newest version (6.0.2-2build1).
cmake is already the newest version (3.22.1-1ubuntu1.22.04.1).
qt5-qmake is already the newest version (5.15.3+dfsg-2ubuntu0.2).
qtbase5-dev is already the newest version (5.15.3+dfsg-2ubuntu0.2).
0 upgraded, 0 newly installed, 0 to remove and 14 not upgraded.
lab2-25@lab225-B250M-D2V:~$
```

6. sudo apt-get install gir1.2-goocanvas-2.0 python3-pygraphviz python3-gi-cairo python3-pygraphviz gir1.2-gtk-3.0

```
E: Unable to locate package pyhton-gi
lab2-25@lab225-B250M-D2V:~$ sudo apt-get install gir1.2-goocanvas-2.0 python3-pygraphviz python3-gi-cairo python3-pygraphviz gir1.2-gtk-3.0
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
gir1.2-goocanvas-2.0 is already the newest version (2.0.4-1build1).
python3-pygraphviz is already the newest version (1.7-3build1).
gir1.2-gtk-3.0 is already the newest version (3.24.33-1ubuntu2).
python3-gi-cairo is already the newest version (3.42.1-0ubuntu1).
0 upgraded, 0 newly installed, 0 to remove and 14 not upgraded.
lab2-25@lab225-B250M-D2V:~$
```

7. sudo apt-get install gdb valgrind

```
lab2-25@lab225-B250M-D2V:~$ sudo apt-get install gdb valgrind
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
valgrind is already the newest version (1:3.18.1-1ubuntu2).
gdb is already the newest version (12.1-0ubuntu1~22.04).
0 upgraded, 0 newly installed, 0 to remove and 14 not upgraded.
lab2-25@lab225-B250M-D2V:~$
```

8. sudo apt-get install doxygen graphviz imagemagick

```
lab2-25@lab225-B250M-D2V:~$ sudo apt-get install doxygen graphviz imagemagick
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
doxygen is already the newest version (1.9.1-2ubuntu2).
graphviz is already the newest version (2.42.2-6).
imagemagick is already the newest version (8:6.9.11.60+dfsg-1.3ubuntu0.22.04.3).
0 upgraded, 0 newly installed, 0 to remove and 14 not upgraded.
lab2-25@lab225-B250M-D2V:~$
```

9. sudo apt install python3-pip

```
lab2-25@lab225-B250M-D2V:~$ sudo apt install python3-pip
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3-pip is already the newest version (22.0.2+dfsg-1ubuntu0.2).
0 upgraded, 0 newly installed, 0 to remove and 14 not upgraded.
lab2-25@lab225-B250M-D2V:~$
```

10. pip install ipython

```
0 upgraded, 0 newly installed, 0 to remove and 14 not upgraded.
lab2-25@lab225-B250M-D2V:~$ pip install ipython
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: ipython in ./.local/lib/python3.10/site-packages (8.12.0)
Requirement already satisfied: pexpect>4.3 in /usr/lib/python3/dist-packages (from ipython) (4.8.0)
Requirement already satisfied: pickleshare in ./.local/lib/python3.10/site-packages (from ipython) (0.7.5)
Requirement already satisfied: pygments>=2.4.0 in ./.local/lib/python3.10/site-packages (from ipython) (2.14.0)
Requirement already satisfied: matplotlib-inline in ./.local/lib/python3.10/site-packages (from ipython) (0.1.6)
Requirement already satisfied: jedi>=0.16 in ./.local/lib/python3.10/site-packages (from ipython) (0.18.2)
Requirement already satisfied: stack-data in ./.local/lib/python3.10/site-packages (from ipython) (0.6.2)
Requirement already satisfied: backcall in ./.local/lib/python3.10/site-packages (from ipython) (0.2.0)
Requirement already satisfied: decorator in ./.local/lib/python3.10/site-packages (from ipython) (5.1.1)
Requirement already satisfied: traitlets>=5 in ./.local/lib/python3.10/site-packages (from ipython) (5.9.0)
Requirement already satisfied: prompt-toolkit!=3.0.37,<3.1.0,>=3.0.30 in ./.local/lib/python3.10/site-packages (from ipython) (3.0.38)
Requirement already satisfied: parso<0.9.0,>=0.8.0 in ./.local/lib/python3.10/site-packages (from jedi>=0.16->ipython) (0.8.3)
Requirement already satisfied: wcwidth in ./.local/lib/python3.10/site-packages (from prompt-toolkit!=3.0.37,<3.1.0,>=3.0.30->ipython) (0.2.6)
Requirement already satisfied: pure-eval in ./.local/lib/python3.10/site-packages (from stack-data->ipython) (0.2.2)
Requirement already satisfied: asttokens>=2.1.0 in ./.local/lib/python3.10/site-packages (from stack-data->ipython) (2.2.1)
Requirement already satisfied: executing>=1.2.0 in ./.local/lib/python3.10/site-packages (from stack-data->ipython) (1.2.0)
Requirement already satisfied: six in /usr/lib/python3/dist-packages (from asttokens>=2.1.0->stack-data->ipython) (1.16.0)
lab2-25@lab225-B250M-D2V:~$
```

11. sudo apt-get install python3-sphinx dia

```
lab2-25@lab225-B250M-D2V:~$ sudo apt-get install python3-sphinx dia
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3-sphinx is already the newest version (4.3.2-1).
dia is already the newest version (0.97.3+git20160930-9build1).
0 upgraded, 0 newly installed, 0 to remove and 9 not upgraded.
lab2-25@lab225-B250M-D2V:~$
```

12. sudo apt-get install tcpdump

```
lab2-25@lab225-B250M-D2V:~$ sudo apt-get install tcpdump
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
tcpdump is already the newest version (4.99.1-3ubuntu0.1).
0 upgraded, 0 newly installed, 0 to remove and 9 not upgraded.
lab2-25@lab225-B250M-D2V:~$
```

13. sudo apt-get install -y llvm-11 llvm-11-dev clang-11 llvm-11-tools

```
lab2-25@lab225-B250M-D2V:~$ sudo apt-get install -y llvm-11 llvm-11-dev clang-11 llvm-11-tools
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libclang-common-11-dev libclang-cpp11 libclang1-11 libllvm11 llvm-11-linker-tools llvm-11-runtime
Suggested packages:
  clang-11-doc llvm-11-doc
The following NEW packages will be installed:
  clang-11 libclang-common-11-dev libclang-cpp11 libclang1-11 libllvm11 llvm-11 llvm-11-dev llvm-11-linker-tools llvm-11-runtime
  llvm-11-tools
0 upgraded, 10 newly installed, 0 to remove and 9 not upgraded.
Need to get 82.3 MB of archives.
After this operation, 469 MB of additional disk space will be used.
Get:1 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 libllvm11 amd64 1:11.1.0-6 [19.6 MB]
Get:2 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 libclang-cpp11 amd64 1:11.1.0-6 [10.5 MB]
Get:3 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 libclang-common-11-dev amd64 1:11.1.0-6 [5,247 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 llvm-11-linker-tools amd64 1:11.1.0-6 [1,275 kB]
Get:5 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 libclang1-11 amd64 1:11.1.0-6 [6,053 kB]
Get:6 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 clang-11 amd64 1:11.1.0-6 [75.8 kB]
Get:7 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 llvm-11-runtime amd64 1:11.1.0-6 [186 kB]
Get:8 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 llvm-11 amd64 1:11.1.0-6 [9,118 kB]
Get:9 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 llvm-11-tools amd64 1:11.1.0-6 [359 kB]
Get:10 http://in.archive.ubuntu.com/ubuntu jammy/universe amd64 llvm-11-dev amd64 1:11.1.0-6 [29.9 MB]
Fetched 82.3 MB in 52s (1,596 kB/s)
```

14. pip install cxxfilt

```
lab2-25@lab225-B250M-D2V:~$ pip install cxxfilt
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: cxxfilt in ./.local/lib/python3.10/site-packages (0.3.0)
lab2-25@lab225-B250M-D2V:~$
```

15. ./build.py--enable-examples–enable-tests

```
lab2-25@lab225-B250M-D2V:~/Aniket/ns-allinone-3.36.1$ ./build.py --enable-examples --enable-tests
# Build NetAnim
Entering directory `netanim-3.108'
 =>  qmake -v
QMake version 3.1
Using Qt version 5.15.3 in /usr/lib/x86_64-linux-gnu
qmake found
 =>  qmake NetAnim.pro
 =>  make
make: Nothing to be done for 'first'.
Leaving directory `netanim-3.108'
# Building examples (by user request)
# Building tests (by user request)
# Build NS-3
```

16. cdns-3.36.1
17. ./test.py

```
lab2-25@lab225-B250M-D2V:~/Aniket/ns-allinone-3.36.1/ns-3.36.1$ ./test.py
Finished executing the following commands:
cd cmake-cache; cmake --build . -j 7 ; cd ..
[1/733] PASS: TestSuite cosine-antenna-model
[2/733] PASS: TestSuite isotropic-antenna-model
[3/733] PASS: TestSuite aodv-routing-id-cache
[4/733] PASS: TestSuite degrees-radians
[5/733] PASS: TestSuite angles
[6/733] PASS: TestSuite uniform-planar-array-test
```

Practical No: 2

Aim: Installation of NetAnim

Steps:

1. Sudo apt upgrade

```
lab2-@lab2-B250M-D2V:~$ sudo apt upgrade
[sudo] password for lab2-:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
  libjs-jquery-ui
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following packages will be upgraded:
  apt apt-utils cups-browsed cups-filters cups-filters-core-drivers
  distro-info-data gdm3 gir1.2-gdm-1.0 im-config libapt-pkg6.0 libcupsfilters1
  libfontembed1 libgdm1 libglib2.0-0 libglib2.0-bin libglib2.0-data
  libgssapi-krb5-2 libk5crypto3 libkrb5-3 libkrb5support0 libldap-2.5-0
  libldap-common libllvm15 libnss-systemd libpam-systemd libsystemd0 libudev1
  libwebp7 libwebpdemux2 libwebpmux3 linux-firmware linux-libc-dev python3-tz
  systemd systemd-oomd systemd-sysv systemd-timesyncd tzdata
  ubuntu-advantage-tools udev xserver-common xserver-xephyr xserver-xorg-core
  xserver-xorg-legacy
44 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
```

2. sudo apt update

```
lab2-@lab2-B250M-D2V:~$ sudo apt update
Hit:1 http://in.archive.ubuntu.com/ubuntu jammy InRelease
Get:2 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Get:3 http://in.archive.ubuntu.com/ubuntu jammy-updates InRelease [119 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu jammy-backports InRelease [108 kB]
Get:5 http://in.archive.ubuntu.com/ubuntu jammy-updates/universe i386 Packages [
610 kB]
Get:6 http://in.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages
[901 kB]
Fetched 1,848 kB in 3s (616 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
All packages are up to date.
lab2-@lab2-B250M-D2V:~$
```

3. ./ns3 configure

```
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1/ns-3.36.1$ ./ns3 configure
-- Using default output directory /home/lab2-/Desktop/vaibhavi/ns-allinone-3.36.1/ns-3.36.1/build
-- Proceeding without cmake-format
-- find_external_library: SQLite3 was found.
-- Harfbuzz is required by GTK3 and was not found.
-- LibXML2 was found.
-- LibRT was found.
-- Visualizer requires Python bindings
-- GSL was found.
-- docs: doxygen documentation not enabled due to missing dependencies: doxygen;dia
-- Failed to locate sphinx-build executable (missing: SPHINX_EXECUTABLE)
-- docs: sphinx documentation not enabled due to missing dependencies: Sphinx;epstopdf;pdflatex;l
atexmk;convert;dvipng
```

4. ./ns3 build

```
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1/ns-3.36.1$ ./ns3 build
Consolidate compiler generated dependencies of target stdlib_pch
Consolidate compiler generated dependencies of target stdlib_pch_exec
Consolidate compiler generated dependencies of target libantenna-obj
Consolidate compiler generated dependencies of target libaodv-obj
[  0%] Building CXX object CMakeFiles/stdlib_pch_exec.dir/cmake_pch.hxx.gch
[  0%] Building CXX object CMakeFiles/stdlib_pch.dir/cmake_pch.hxx.gch
Consolidate compiler generated dependencies of target libenergy-obj
Consolidate compiler generated dependencies of target libstats-obj
```

5. cd and ls

```
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1/ns-3.36.1$ cd ..
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1$ ls
bake       constants.py   ns-3.36.1          __pycache__   util.py
build.py   netanim-3.108  pybindgen-0.22.1   README.md
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1$ cd netanim-3.108
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1/netanim-3.108$ ls
abort.h                      moc_fileedit.cpp
animatorconstants.h          moc_fileeditfactory.cpp
animator_fileopen.svg        moc_fileeditfactory.o
animator_grid.svg            moc_fileedit.o
animatormode.cpp             moc_filepathmanager.cpp
animatormode.h               moc_filepathmanager.o
animatormode.o               moc_netanim.cpp
animator_mouseposition.png   moc_netanim.o
```

6. makeclean

```
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1/netanim-3.108$ make clean
rm -f qrc_resources.cpp qrc_qtpropertybrowser.cpp
rm -f moc_predefs.h
rm -f moc_animatorscene.cpp moc_animpacket.cpp moc_netanim.cpp moc_animatormode.cpp moc_statsmode.cpp
moc_qtvariantproperty.cpp moc_qttreepropertybrowser.cpp moc_qtpropertymanager.cpp moc_qtpropertybrowse
rutils_p.cpp moc_qtpropertybrowser.cpp moc_qtgroupboxpropertybrowser.cpp moc_qteditorfactory.cpp moc_q
tbuttonpropertybrowser.cpp moc_animpropertybrowser.cpp moc_filepathmanager.cpp moc_fileeditfactory.cpp
 moc_fileedit.cpp moc_packetsmode.cpp moc_table.cpp moc_qcustomplot.cpp
rm -f qttreepropertybrowser.moc qtpropertymanager.moc qteditorfactory.moc
rm -f main.o log.o fatal-error.o fatal-impl.o logqt.o resizeableitem.o animnode.o animatorscene.o anim
packet.o netanim.o animatormode.o mode.o animxmlparser.o animatorview.o animlink.o animresource.o stat
sview.o statsmode.o routingxmlparser.o routingstatsscene.o interfacestatsscene.o flowmonxmlparser.o fl
owmonstatsscene.o textbubble.o qtvariantproperty.o qttreepropertybrowser.o qtpropertymanager.o qtprope
rtybrowserutils.o qtpropertybrowser.o qtgroupboxpropertybrowser.o qteditorfactory.o qtbuttonpropertybr
owser.o animpropertybrowser.o filepathmanager.o fileeditfactory.o fileedit.o packetsmode.o packetsview
.o packetsscene.o graphpacket.o table.o countertablesscene.o qcustomplot.o qrc_resources.o qrc_qtprope
rtybrowser.o moc_animatorscene.o moc_animpacket.o moc_netanim.o moc_animatormode.o moc_statsmode.o moc
_qtpropertybrowserutils_p.o moc_animpropertybrowser.o moc_filepathmanager.o moc_fileeditfactory.o moc_
fileedit.o moc_packetsmode.o moc_table.o moc_qcustomplot.o
rm -f *~ core *.core
```

7. qmakeNetAnim.pro

```
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1/netanim-3.108$ qmake NetAnim.pro
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1/netanim-3.108$
```

8. ./NetAnim

```
lab2-@lab2-B250M-D2V:~/Desktop/vaibhavi/ns-allinone-3.36.1/netanim-3.108$ ./NetAnim
Warning: Ignoring XDG_SESSION_TYPE=wayland on Gnome. Use QT_QPA_PLATFORM=wayland to run on Wayland any
way.
```

Practical No: 3

Aim: Installation of Wireshark

Steps:

1. sudo apt upgrade

```
lab2-@lab2-B250M-D2V:~$ sudo apt upgrade
[sudo] password for lab2-:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
  libjs-jquery-ui
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following packages will be upgraded:
  apt apt-utils cups-browsed cups-filters cups-filters-core-drivers
  distro-info-data gdm3 gir1.2-gdm-1.0 im-config libapt-pkg6.0 libcupsfilters1
  libfontembed1 libgdm1 libglib2.0-0 libglib2.0-bin libglib2.0-data
  libgssapi-krb5-2 libk5crypto3 libkrb5-3 libkrb5support0 libldap-2.5-0
  libldap-common libllvm15 libnss-systemd libpam-systemd libsystemd0 libudev1
  libwebp7 libwebpdemux2 libwebpmux3 linux-firmware linux-libc-dev python3-tz
  systemd systemd-oomd systemd-sysv systemd-timesyncd tzdata
  ubuntu-advantage-tools udev xserver-common xserver-xephyr xserver-xorg-core
  xserver-xorg-legacy
44 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
```

2. sudo apt update

```
lab2-@lab2-B250M-D2V:~$ sudo apt update
Hit:1 http://in.archive.ubuntu.com/ubuntu jammy InRelease
Get:2 http://security.ubuntu.com/ubuntu jammy-security InRelease [110 kB]
Get:3 http://in.archive.ubuntu.com/ubuntu jammy-updates InRelease [119 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu jammy-backports InRelease [108 kB]
Get:5 http://in.archive.ubuntu.com/ubuntu jammy-updates/universe i386 Packages [
610 kB]
Get:6 http://in.archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages
[901 kB]
Fetched 1,848 kB in 3s (616 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
All packages are up to date.
lab2-@lab2-B250M-D2V:~$
```

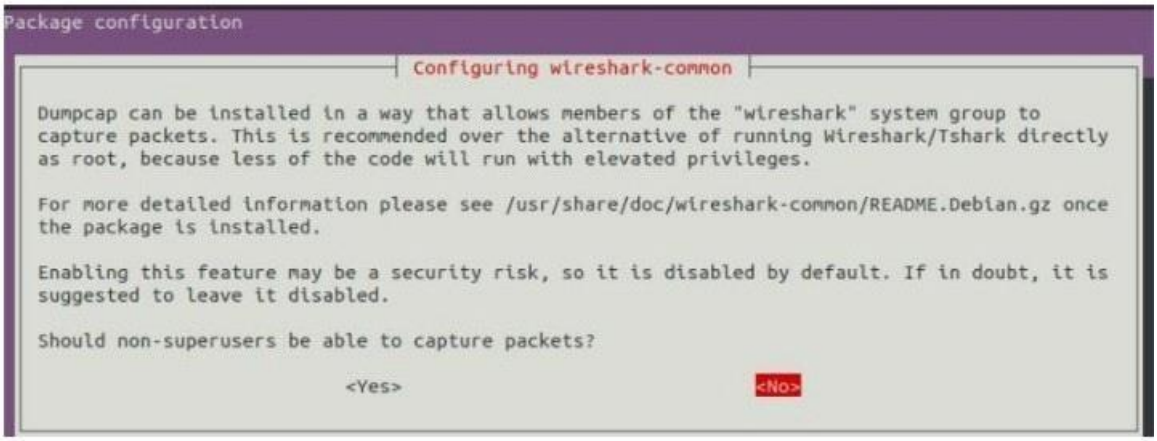
3. sudo add-apt-repository ppa:wireshark-dev/stable

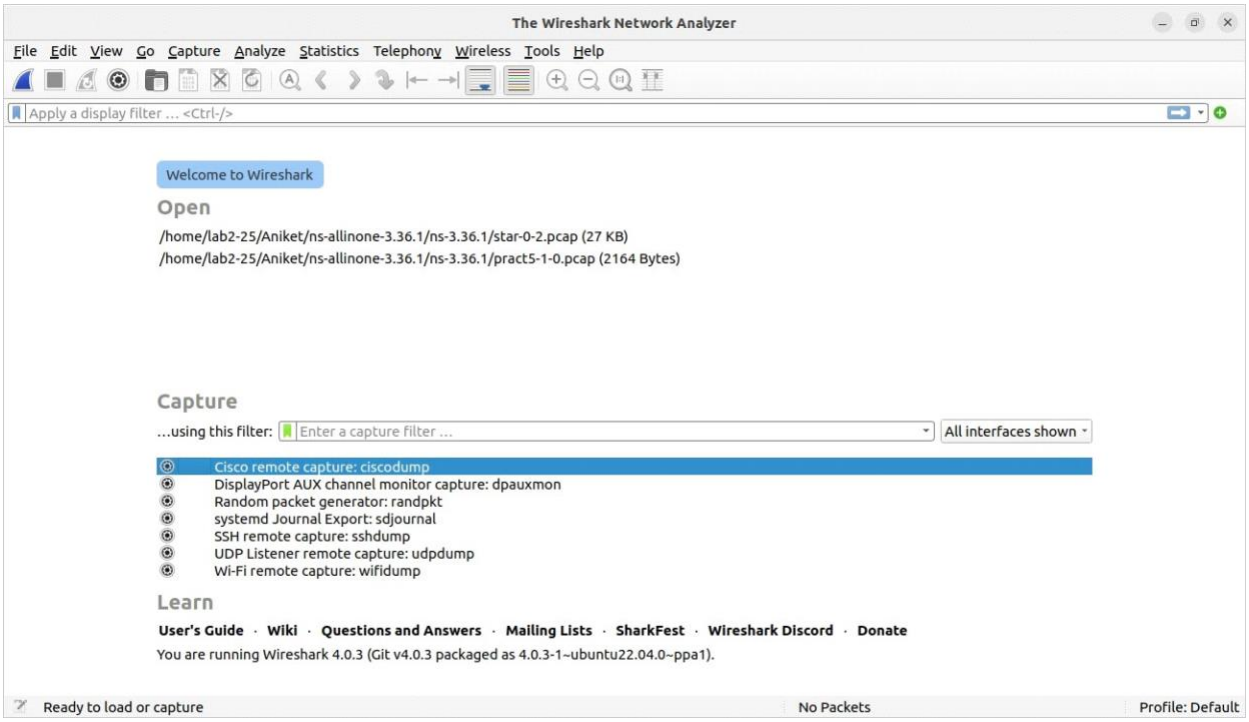
```
lab2-25@lab225-B250M-D2V:~/Aniket$ cd ..
lab2-25@lab225-B250M-D2V: $ sudo add-apt-repository ppa:wireshark-dev/stable
PPA publishes dbgsym, you may need to include 'main/debug' component
Repository: 'deb https://ppa.launchpadcontent.net/wireshark-dev/stable/ubuntu/ jammy main'
Description:
Latest stable Wireshark releases back-ported from Debian package versions.

Back-porting script is available at https://github.com/rbalint/pkg-wireshark-ubuntu-ppa

From Ubuntu 16.04 you also need to enable "universe"  repository, see:
http://askubuntu.com/questions/148638/how-do-i-enable-the-universe-repository

The packaging repository for Debian and Ubuntu is at: https://salsa.debian.org/debian/wireshark
More info: https://launchpad.net/~wireshark-dev/+archive/ubuntu/stable
Adding repository.
Press [ENTER] to continue or Ctrl-c to cancel.
Adding deb entry to /etc/apt/sources.list.d/wireshark-dev-ubuntu-stable-jammy.list
Adding disabled deb-src entry to /etc/apt/sources.list.d/wireshark-dev-ubuntu-stable-jammy.list
Adding key to /etc/apt/trusted.gpg.d/wireshark-dev-ubuntu-stable.gpg with fingerprint A2E402B85A4B70CD78D8A3D9D875551314ECA0F0
Hit:1 http://in.archive.ubuntu.com/ubuntu jammy InRelease
0% [Waiting for headers] [Waiting for headers] [Connected to ppa.launchpadcontent.net (185.125.190.52)]
```

4. sudo apt install wireshark

```
lab2-25@lab225-B250M-D2V:~$ sudo apt install wireshark
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libwireshark15 libwiretap12 libwsutil13
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  libwireshark-data libwireshark16 libwiretap13 libwsutil14 wireshark-common wireshark-qt
Suggested packages:
  geoipupdate geoip-database geoip-database-extra libjs-leaflet libjs-leaflet.markercluster snmp-mibs-downloader wireshark-doc
The following NEW packages will be installed:
  libwireshark16 libwiretap13 libwsutil14
The following packages will be upgraded:
  libwireshark-data wireshark wireshark-common wireshark-qt
4 upgraded, 3 newly installed, 0 to remove and 3 not upgraded.
Need to get 28.2 MB of archives.
After this operation, 115 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 https://ppa.launchpadcontent.net/wireshark-dev/stable/ubuntu jammy/main amd64 libwireshark-data all 4.0.3-1~ubuntu22.04.0~ppa1 [1,744 kB
]
Get:2 https://ppa.launchpadcontent.net/wireshark-dev/stable/ubuntu jammy/main amd64 libwsutil14 amd64 4.0.3-1~ubuntu22.04.0~ppa1 [142 kB]
```

5. configuring wireshark click yes




The Wireshark Network Analyzer
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
Welcome to Wireshark
Open
/home/lab2-25/Aniket/ns-allinone-3.36.1/ns-3.36.1/star-0-2.pcap (27 KB)
/home/lab2-25/Aniket/ns-allinone-3.36.1/ns-3.36.1/pract5-1-0.pcap (2164 Bytes)
Capture
...using this filter: Enter a capture filter ...
All interfaces shown
Cisco remote capture: ciscodump
DisplayPort AUX channel monitor capture: dpauxmon
Random packet generator: randpkt
systemd Journal Export: sdjournal
SSH remote capture: sshdump
UDP Listener remote capture: udpdump
Wi-Fi remote capture: wifidump
Learn
User's Guide · Wiki · Questions and Answers · Mailing Lists · SharkFest · Wireshark Discord · Donate
You are running Wireshark 4.0.3 (Git v4.0.3 packaged as 4.0.3-1~ubuntu22.04.0~ppa1).
Ready to load or capture
No Packets
Profile: Default

Practical No: 4

Aim: Program to simulate traffic between two nodes

Code:
Point.cc

```
#include "ns3/core-module.h"
#include "ns3/network-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/applications-module.h"
#include "ns3/netanim-module.h"
#include "ns3/mobility-module.h"
// Default Network Topology
//10.1.1.0
// n0 - - - - - - - - -  n1
//
//point-to-point
//
using namespace ns3;
NS_LOG_COMPONENT_DEFINE ("FirstScriptExample");
int
main (int argc, char *argv[])
{
CommandLine cmd (__FILE__);
cmd.Parse (argc, argv);
Time::SetResolution (Time::NS);
LogComponentEnable ("UdpEchoClientApplication",
LOG_LEVEL_INFO);
LogComponentEnable ("UdpEchoServerApplication",
LOG_LEVEL_INFO);
NodeContainer nodes;
nodes.Create (2);
PointToPointHelper pointToPoint;
pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));
NetDeviceContainer devices;
devices = pointToPoint.Install (nodes);
InternetStackHelper stack;
stack.Install (nodes);
Ipv4AddressHelper address;
address.SetBase ("10.1.1.0", "255.255.255.0");
Ipv4InterfaceContainer interfaces = address.Assign (devices);
UdpEchoServerHelper echoServer (9);
ApplicationContainer serverApps = echoServer.Install (nodes.Get (1));
serverApps.Start (Seconds (1.0));
serverApps.Stop (Seconds (10.0));
UdpEchoClientHelper echoClient (interfaces.GetAddress (1), 9);
```

```
echoClient.SetAttribute ("MaxPackets", UintegerValue (1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UintegerValue (1024));
ApplicationContainer clientApps = echoClient.Install (nodes.Get (0));
clientApps.Start (Seconds (2.0));
clientApps.Stop (Seconds (10.0));
MobilityHelper mobility;
mobility.SetMobilityModel("ns3::ConstantPositionMobilityModel");
mobility.Install(nodes);
AnimationInterface anim("first.xml");
AnimationInterface::SetConstantPosition(nodes.Get(0),10,25);
AnimationInterface::SetConstantPosition(nodes.Get(1),40,25);
anim.EnablePacketMetadata(true);
pointToPoint.EnablePcapAll("point");
Simulator::Run ();
Simulator::Destroy ();
return 0; }
```

Output:

```
Consolidate compiler generated dependencies of target libolsr-obj
Consolidate compiler generated dependencies of target libsixlowpan-obj
Consolidate compiler generated dependencies of target libtap-bridge-obj
Consolidate compiler generated dependencies of target libtopology-read-obj
[  0%] Building CXX object scratch/CMakeFiles/scratch_firenet.dir/firenet.cc.o
[  0%] Linking CXX executable ../../build/scratch/ns3.36.1-firenet-default
At time +2s client sent 1024 bytes to 10.1.1.2 port 9
At time +2.00369s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00369s server sent 1024 bytes to 10.1.1.1 port 49153
At time +2.00737s client received 1024 bytes from 10.1.1.2 port 9
```

```
Consolidate compiler generated dependencies of target libtopology-read-obj
[  0%] Building CXX object scratch/CMakeFiles/scratch_prac.dir/prac.cc.o
[  0%] Linking CXX executable ../../build/scratch/ns3.36.1-prac-default
At time +2s client sent 1024 bytes to 10.1.1.2 port 9
At time +2.00369s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00369s server sent 1024 bytes to 10.1.1.1 port 49153
At time +2.00737s client received 1024 bytes from 10.1.1.2 port 9
lab2-42@lab242-B250M-D2V:~/Desktop/saurabh_92/ns-allinone-3.36.1/ns-3.36.1$ cd ..
lab2-42@lab242-B250M-D2V:~/Desktop/saurabh_92/ns-allinone-3.36.1$ cd netanim-3.108
lab2-42@lab242-B250M-D2V:~/Desktop/saurabh_92/ns-allinone-3.36.1/netanim-3.108$ ./NetAnim
```

Practical No: 4.1

Aim: Point to point topology with ns3 & Net-

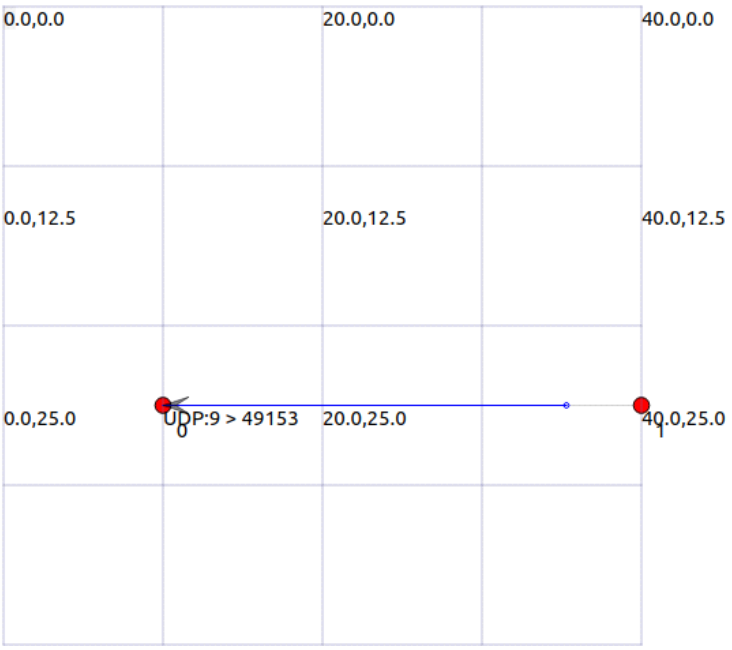
Anim. Code:

```
#include "ns3/core-module.h"
#include "ns3/network-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/applications-module.h"
#include "ns3/netanim-module.h"
#include "ns3/mobility-module.h"
// Default Network Topology

//10.1.1.0

// n0 _____ n1

//

//point-to-point

//

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("FirstScriptExample"); int
main (int argc, char *argv[])

{

CommandLine cmd (
_____F
ILE_____);
cmd.Parse (argc, argv);
Time::SetResolution
(Time::NS);
LogComponentEnable ("UdpEchoClientApplication",
LOG_LEVEL_INFO);
LogComponentEnable ("UdpEchoServerApplication",
LOG_LEVEL_INFO);
NodeContainer nodes;
nodes.Create (2);
PointToPointHelper pointToPoint;
pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));
NetDeviceContainer devices;
devices = pointToPoint.Install (nodes);
InternetStackHelper stack; stack.Install
(nodes);
Ipv4AddressHelper address;
address.SetBase ("10.1.1.0", "255.255.255.0");
Ipv4InterfaceContainer interfaces = address.Assign (devices);
```

```
UdpEchoServerHelper echoServer (9);
ApplicationContainer serverApps = echoServer.Install (nodes.Get (1));
serverApps.Start (Seconds (1.0));
serverApps.Stop (Seconds (10.0));

UdpEchoClientHelper echoClient (interfaces.GetAddress (1), 9);
echoClient.SetAttribute ("MaxPackets", UintegerValue (1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UintegerValue (1024));
ApplicationContainer clientApps = echoClient.Install (nodes.Get (0));
clientApps.Start (Seconds (2.0));
clientApps.Stop (Seconds (10.0));
MobilityHelper mobility;
mobility.SetMobilityModel("ns3::ConstantPositionMobilityModel");
mobility.Install(nodes);
AnimationInterface anim("first.xml");
AnimationInterface::SetConstantPosition(nodes.Get(0),10,25);
AnimationInterface::SetConstantPosition(nodes.Get(1),40,25);
anim.EnablePacketMetadata(true);
pointToPoint.EnablePcapAll("pract2Mana");
Simulator::Run
();
Simulator::Destro
y (); return 0; }
```

Output:


slow
Sim time
2.0056864
Lines
5
Node Size
1
IP


0.0,0.0
20.0,0.0
40.0,0.0
0.0,12.5
20.0,12.5
40.0,12.5
0.0,25.0
UDP:9 > 49153
20.0,25.0
40.0,25.0
0
1

Practical No: 5

Aim: Program to simulate star topology

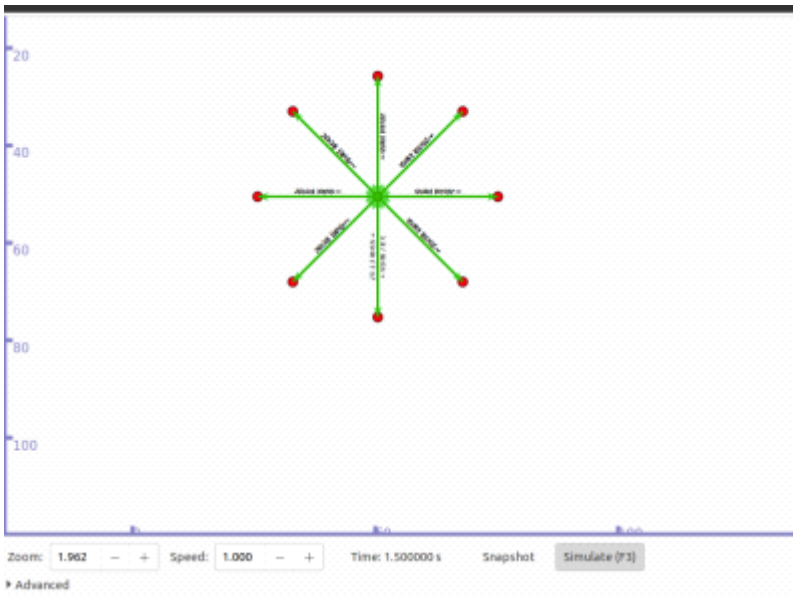
Code:

```
#include "ns3/network-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-star.h"
#include "ns3/applications-module.h"
#include "ns3/netanim-module.h"
#include "ns3/mobility-module.h"
#include "ns3/onoff-application.h"
using namespace ns3;
//NS_LOG_COMPONENT_DEFINE ("Star");
NS_LOG_COMPONENT_DEFINE ("StarExample");
int
main (int argc, char *argv[])
{
// Set up some default values for the simulation.
Config::SetDefault ("ns3::OnOffApplication::PacketSize",
UintegerValue (137));
// ??? try and stick 15kb/s into the data rate
Config::SetDefault ("ns3::OnOffApplication::DataRate", StringValue
("14kb/s"));
// Default number of nodes in the star. Overridable by command line argument.
uint32_t nSpokes = 8;
CommandLine cmd (__FILE__);
cmd.AddValue ("nSpokes", "Number of nodes to place in the star",nSpokes);
cmd.Parse (argc, argv);
LogComponentEnable ("UdpEchoClientApplication",LOG_LEVEL_INFO);
LogComponentEnable ("UdpEchoServerApplication",
LOG_LEVEL_INFO);
NS_LOG_INFO ("Build star topology.");
PointToPointHelper pointToPoint;
pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));
PointToPointStarHelper star (nSpokes, pointToPoint);
NS_LOG_INFO ("Install internet stack on all nodes.");
InternetStackHelper internet;
star.InstallStack (internet);
NS_LOG_INFO ("Assign IP Addresses.");
star.AssignIpv4Addresses (Ipv4AddressHelper ("10.1.1.0",
"255.255.255.0"));
NS_LOG_INFO ("Create applications.");
// Create a packet sink on the star "hub" to receive packets.
uint16_t port = 50000;
Address hubLocalAddress (InetSocketAddress (Ipv4Address::GetAny
(), port));
PacketSinkHelper packetSinkHelper ("ns3::TcpSocketFactory",
hubLocalAddress);
```

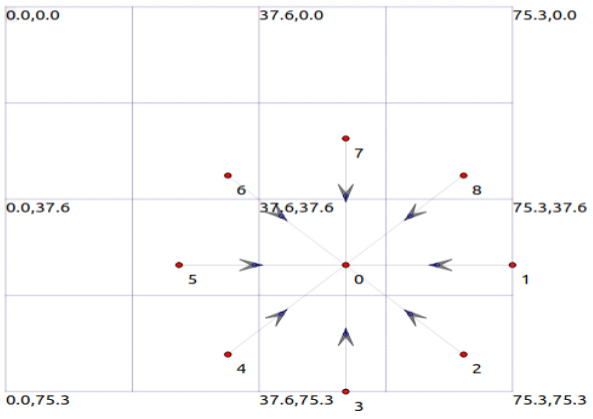
```
ApplicationContainer hubApp = packetSinkHelper.Install (star.GetHub
());
hubApp.Start (Seconds (1.0));
hubApp.Stop (Seconds (10.0));
// Create OnOff applications to send TCP to the hub, one on each spokenode.
OnOffHelper onOffHelper ("ns3::TcpSocketFactory", Address ());
onOffHelper.SetAttribute ("OnTime",
StringValue("ns3::ConstantRandomVariable[Constant=1]"));
onOffHelper.SetAttribute ("OffTime",
StringValue("ns3::ConstantRandomVariable[Constant=0]"));
ApplicationContainer spokeApps;
for (uint32_t i = 0; i < star.SpokeCount (); ++i)
{
AddressValue remoteAddress (InetSocketAddress
(star.GetHubIpv4Address (i), port));
onOffHelper.SetAttribute ("Remote", remoteAddress);
spokeApps.Add (onOffHelper.Install (star.GetSpokeNode (i)));
}
spokeApps.Start (Seconds (1.0));
spokeApps.Stop (Seconds (10.0));
NS_LOG_INFO ("Enable static global routing.");
// Turn on global static routing so we can actually be routed across thestar.
Ipv4GlobalRoutingHelper::PopulateRoutingTables ();
NS_LOG_INFO ("Enable pcap tracing.");
//
// Do pcap tracing on all point-to-point devices on all nodes.
//
pointToPoint.EnablePcapAll ("star");
star.BoundingBox(1,1,100,100);
AnimationInterface anim("star.xml");
NS_LOG_INFO ("Run Simulation.");
Simulator::Run ();
Simulator::Destroy ();
NS_LOG_INFO ("Done.");
return 0;
}
```

Output:

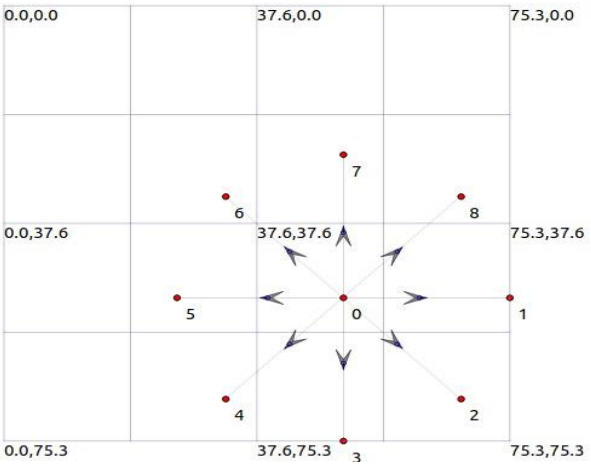
```
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32/scratch$ cd ..
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32$ ./waf --run scratch/pract3Mana
Waf: Entering directory `/home/lab2/workspace/ns-allinone-3.32/ns-3.32/build'
Waf: Leaving directory `/home/lab2/workspace/ns-allinone-3.32/ns-3.32/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (0.683s)
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32$ ./waf --run scratch/pract3Mana --vis
Waf: Entering directory `/home/lab2/workspace/ns-allinone-3.32/ns-3.32/build'
Waf: Leaving directory `/home/lab2/workspace/ns-allinone-3.32/ns-3.32/build'
Build commands will be stored in build/compile_commands.json
'build' finished successfully (0.689s)
Could not load plugin 'show_last_packets.py': No module named 'kiwi'
Could not load icon applets-screenshooter due to missing gnomedesktop Python module
scanning topology: 9 nodes...
scanning topology: calling graphviz layout
scanning topology: all done.
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32$
```

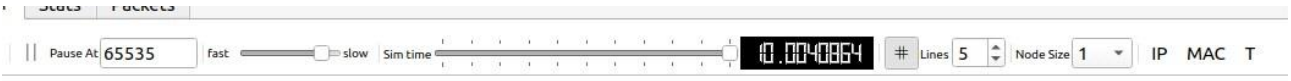


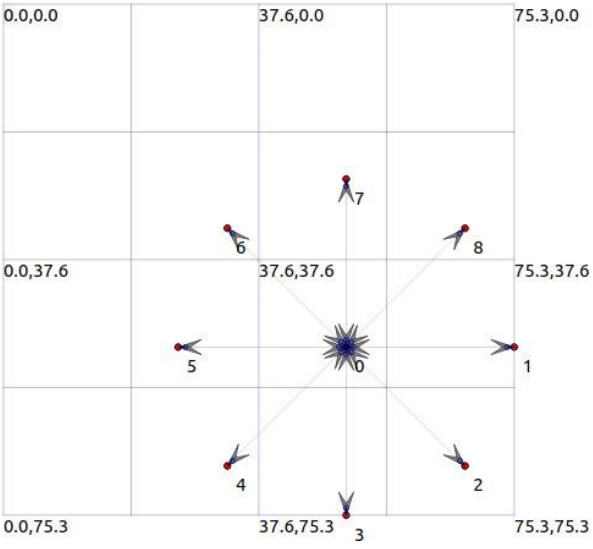

```
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32$ cd ..
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32$ cd netanim-3.108
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/netanim-3.108$ ./NetAnim
```




use At 65535
fast
slow
Sim time
2.02 40 1989
Lines 5
Node Size 1
IP
M


0.0,0.0
37.6,0.0
75.3,0.0
0.0,37.6
37.6,37.6
75.3,37.6
0.0,75.3
37.6,75.3
75.3,75.3
0
1
2
3
4
5
6
7
8


Pause At 65535
fast
slow
Sim time
40.0040864
Lines 5
Node Size 1
IP
MAC
T


0.0,0.0
37.6,0.0
75.3,0.0
0.0,37.6
37.6,37.6
75.3,37.6
0.0,75.3
37.6,75.3
75.3,75.3
0
1
2
3
4
5
6
7
8

Practical No: 6

Aim: Program to simulate bus topology

Code:

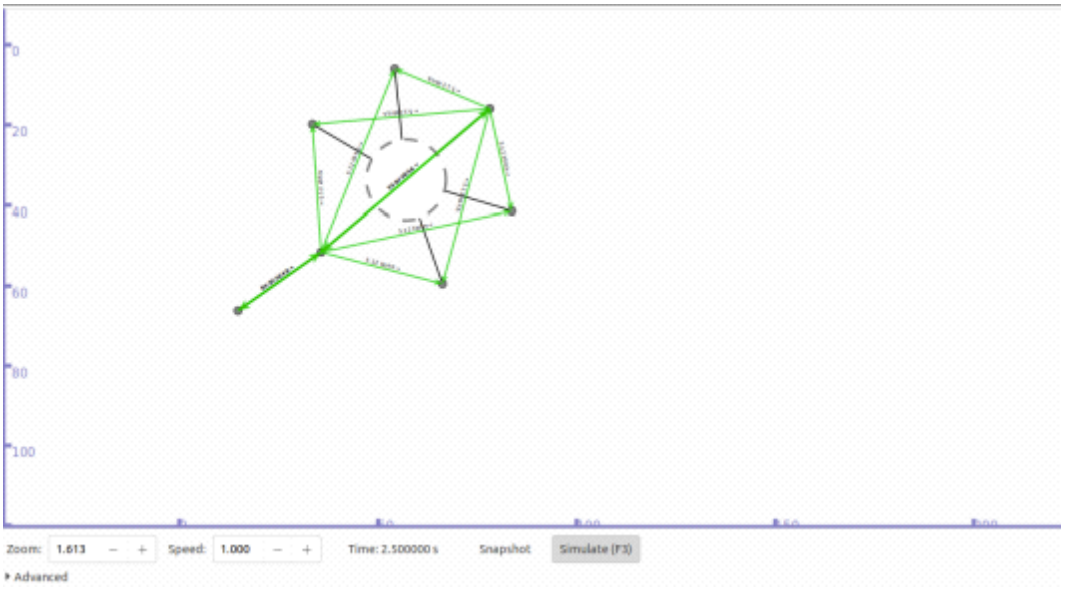
pract7.cc

```
#include "ns3/core-module.h"
#include "ns3/network-module.h"
#include "ns3/csma-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/applications-module.h"
#include "ns3/ipv4-global-routing-helper.h"
// Default Network Topology
//
//
//10.1.1.0
// n0 ---------- n1 n2 n3 n4
//
//
//
//point-to-point | | |
//|
//================
//LAN 10.1.2.0
using namespace ns3;
NS_LOG_COMPONENT_DEFINE ("SecondScriptExample");
int
main (int argc, char *argv[])
{
bool verbose = true;
uint32_t nCsma = 5;
CommandLine cmd (__FILE__);
cmd.AddValue ("nCsma", "Number of \"extra\" CSMA nodes/devices", nCsma);
cmd.AddValue ("verbose", "Tell echo applications to log if true", verbose);
cmd.Parse (argc,argv);
if (verbose)
{
LogComponentEnable ("UdpEchoClientApplication", LOG_LEVEL_INFO);
LogComponentEnable ("UdpEchoServerApplication", LOG_LEVEL_INFO);
nCsma = nCsma == 0 ? 1 : nCsma;
NodeContainer p2pNodes;
p2pNodes.Create (2);
NodeContainer csmaNodes;
csmaNodes.Add (p2pNodes.Get (1));
csmaNodes.Create (nCsma);
PointToPointHelper pointToPoint;
pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("10Mbps"));
pointToPoint.SetChannelAttribute ("Delay", StringValue ("5ms"));
```

```
NetDeviceContainer p2pDevices;
p2pDevices = pointToPoint.Install (p2pNodes);
CsmaHelper csma;
csma.SetChannelAttribute ("DataRate", StringValue ("100Mbps"));
csma.SetChannelAttribute ("Delay", TimeValue (NanoSeconds (6560)));
NetDeviceContainer csmaDevices;
csmaDevices = csma.Install (csmaNodes);
InternetStackHelper stack;
stack.Install (p2pNodes.Get (0));
stack.Install (csmaNodes);
Ipv4AddressHelper address;
address.SetBase ("10.1.1.0", "255.255.255.0");
Ipv4InterfaceContainer p2pInterfaces;
p2pInterfaces = address.Assign (p2pDevices);
address.SetBase ("10.1.2.0", "255.255.255.0");
Ipv4InterfaceContainer csmaInterfaces;
csmaInterfaces = address.Assign (csmaDevices);
UdpEchoServerHelper echoServer (9);
ApplicationContainer serverApps = echoServer.Install (csmaNodes.Get (nCsma));
serverApps.Start (Seconds (1.0));
serverApps.Stop (Seconds (10.0));
UdpEchoClientHelper echoClient (csmaInterfaces.GetAddress (nCsma), 9);
echoClient.SetAttribute ("MaxPackets", UintegerValue (1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UintegerValue (1024));
ApplicationContainer clientApps = echoClient.Install (p2pNodes.Get (0));
clientApps.Start (Seconds (2.0));
clientApps.Stop (Seconds (10.0));
Ipv4GlobalRoutingHelper::PopulateRoutingTables ();
pointToPoint.EnablePcapAll ("pract2Mana");
csma.EnablePcap ("pract2Mana", csmaDevices.Get (1), true);
Simulator::Run ();
Simulator::Destroy ();
return 0;
}
}
```

Output:

```
[  0%] Building CXX object scratch/CMakeFiles/scratch_practical7.dir/practical7.cc.o
[  0%] Linking CXX executable ../../build/scratch/ns3.36.1-practical7-default
At time +2s client sent 1024 bytes to 10.1.2.6 port 9
At time +2.00596s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00596s server sent 1024 bytes to 10.1.1.1 port 49153
At time +2.01192s client received 1024 bytes from 10.1.2.6 port 9
lab2-42@lab242-B250M-D2V:~/Desktop/saurabh_92/ns-allinone-3.36.1/ns-3.36.1$ ./ns3 run scratch/practical7 -- vis
Consolidate compiler generated dependencies of target scratch_practical7
At time +2s client sent 1024 bytes to 10.1.2.6 port 9
At time +2.00596s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00596s server sent 1024 bytes to 10.1.1.1 port 49153
At time +2.01192s client received 1024 bytes from 10.1.2.6 port 9
lab2-42@lab242-B250M-D2V:~/Desktop/saurabh_92/ns-allinone-3.36.1/ns-3.36.1$
```



Practical No: 7

Aim: Program to simulate mesh topology

Code:
practmesh.cc

```
#include "ns3/applications-module.h"
#include "ns3/core-module.h"
#include "ns3/internet-module.h"
#include "ns3/mesh-helper.h"
#include "ns3/mesh-module.h"
#include "ns3/mobility-module.h"
#include "ns3/network-module.h"
#include "ns3/yans-wifi-helper.h"
#include <fstream>
#include <iostream>
#include <sstream>
using namespace ns3;
NS_LOG_COMPONENT_DEFINE("MeshExample");
// Declaring these variables outside of main() for use in trace sinks
uint32_t g_udpTxCount = 0; //!< Rx packet counter.
uint32_t g_udpRxCount = 0; //!< Tx packet counter.
/**
* Transmission trace sink.
*
* \param p The sent packet.
*/
void
TxTrace(Ptr<const Packet> p)
{
NS_LOG_DEBUG("Sent " << p->GetSize() << " bytes");
g_udpTxCount++;
}
/**
* Reception trace sink,
*
* \param p The received packet.
*/
void
RxTrace(Ptr<const Packet> p)
{
NS_LOG_DEBUG("Received " << p->GetSize() << " bytes");
g_udpRxCount++;
}
/**
* \ingroup mesh
* \brief MeshTest class
*/
```

```
class MeshTest
{
public:
/// Init test

MeshTest();
/**
* Configure test from command line arguments
*
* \param argc command line argument count
* \param argv command line arguments
*/
void Configure(int argc, char** argv);
/**
* Run test
* \returns the test status
*/
int Run();
private:
int m_xSize; ///< X size
int m_ySize; ///< Y size
double m_step; ///< step
double m_randomStart; ///< random start
double m_totalTime; ///< total time
double m_packetInterval; ///< packet interval
uint16_t m_packetSize; ///< packet size
uint32_t m_nIfaces; ///< number interfaces
bool m_chan; ///< channel
bool m_pcap; ///< PCAP
bool m_ascii; ///< ASCII
std::string m_stack; ///< stack
std::string m_root; ///< root
/// List of network nodes
NodeContainer nodes;
/// List of all mesh point devices
NetDeviceContainer meshDevices;
/// Addresses of interfaces:
Ipv4InterfaceContainer interfaces;
/// MeshHelper. Report is not static methods
MeshHelper mesh;
private:
/// Create nodes and setup their mobility
void CreateNodes();
/// Install internet m_stack on nodes
void InstallInternetStack();
/// Install applications
void InstallApplication();
/// Print mesh devices diagnostics
void Report();
};
```

```
MeshTest::MeshTest()
: m_xSize(3),
m_ySize(3),
m_step(50.0),
m_randomStart(0.1),
m_totalTime(100.0),
m_packetInterval(1),
m_packetSize(1024),
m_nIfaces(1),

m_chan(true),
m_pcap(false),
m_ascii(false),
m_stack("ns3::Dot11sStack"),
m_root("ff:ff:ff:ff:ff:ff")
{
}
void
MeshTest::Configure(int argc, char* argv[])
{
CommandLine cmd(__FILE__);
cmd.AddValue("x-size", "Number of nodes in a row grid", m_xSize);
cmd.AddValue("y-size", "Number of rows in a grid", m_ySize);
cmd.AddValue("step", "Size of edge in our grid (meters)", m_step);
// Avoid starting all mesh nodes at the same time (beacons may collide)
cmd.AddValue("start", "Maximum random start delay for beacon jitter (sec)",
m_randomStart);
cmd.AddValue("time", "Simulation time (sec)", m_totalTime);
cmd.AddValue("packet-interval", "Interval between packets in UDP ping (sec)",
m_packetInterval);
cmd.AddValue("packet-size", "Size of packets in UDP ping (bytes)", m_packetSize);
cmd.AddValue("interfaces", "Number of radio interfaces used by each mesh point",
m_nIfaces);
cmd.AddValue("channels", "Use different frequency channels for different interfaces",
m_chan);
cmd.AddValue("pcap", "Enable PCAP traces on interfaces", m_pcap);
cmd.AddValue("ascii", "Enable Ascii traces on interfaces", m_ascii);
cmd.AddValue("stack", "Type of protocol stack. ns3::Dot11sStack by default", m_stack);
cmd.AddValue("root", "Mac address of root mesh point in HWMP", m_root);
cmd.Parse(argc, argv);
NS_LOG_DEBUG("Grid:" << m_xSize << "*" << m_ySize);
NS_LOG_DEBUG("Simulation time: " << m_totalTime << " s");
if (m_ascii)
{
PacketMetadata::Enable();
}
}
void
MeshTest::CreateNodes()
{
```

```
/*
* Create m_ySize*m_xSize stations to form a grid topology
*/
nodes.Create(m_ySize * m_xSize);
// Configure YansWifiChannel
YansWifiPhyHelper wifiPhy;
YansWifiChannelHelper wifiChannel = YansWifiChannelHelper::Default();
wifiPhy.SetChannel(wifiChannel.Create());
/*
* Create mesh helper and set stack installer to it
* Stack installer creates all needed protocols and install them to
* mesh point device
*/
mesh = MeshHelper::Default();
if (!Mac48Address(m_root.c_str()).IsBroadcast())
{
mesh.SetStackInstaller(m_stack, "Root",
Mac48AddressValue(Mac48Address(m_root.c_str())));
}

else
{
// If root is not set, we do not use "Root" attribute, because it
// is specified only for 11s
mesh.SetStackInstaller(m_stack);
}
if (m_chan)
{
mesh.SetSpreadInterfaceChannels(MeshHelper::SPREAD_CHANNELS);
}
else
{
mesh.SetSpreadInterfaceChannels(MeshHelper::ZERO_CHANNEL);
}
mesh.SetMacType("RandomStart", TimeValue(Seconds(m_randomStart)));
// Set number of interfaces - default is single-interface mesh point
mesh.SetNumberOfInterfaces(m_nIfaces);
// Install protocols and return container if MeshPointDevices
meshDevices = mesh.Install(wifiPhy, nodes);
// AssignStreams can optionally be used to control random variable streams
mesh.AssignStreams(meshDevices, 0);
// Setup mobility - static grid topology
MobilityHelper mobility;
mobility.SetPositionAllocator("ns3::GridPositionAllocator",

"MinX",
DoubleValue(0.0),
"MinY",
DoubleValue(0.0),
"DeltaX",
```

```
DoubleValue(m_step),
"DeltaY",
DoubleValue(m_step),
"GridWidth",
UintegerValue(m_xSize),
"LayoutType",
StringValue("RowFirst"));

mobility.SetMobilityModel("ns3::ConstantPositionMobilityModel");
mobility.Install(nodes);
if (m_pcap)
{
wifiPhy.EnablePcapAll(std::string("mp"));
}
if (m_ascii)
{
AsciiTraceHelper ascii;
wifiPhy.EnableAsciiAll(ascii.CreateFileStream("mesh.tr"));
}
}
void
MeshTest::InstallInternetStack()
{
InternetStackHelper internetStack;
internetStack.Install(nodes);
Ipv4AddressHelper address;
address.SetBase("10.1.1.0", "255.255.255.0");
interfaces = address.Assign(meshDevices);

}
void
MeshTest::InstallApplication()
{
uint16_t portNumber = 9;
UdpEchoServerHelper echoServer(portNumber);
uint16_t sinkNodeId = m_xSize * m_ySize - 1;
ApplicationContainer serverApps = echoServer.Install(nodes.Get(sinkNodeId));
serverApps.Start(Seconds(1.0));
serverApps.Stop(Seconds(m_totalTime + 1));
UdpEchoClientHelper echoClient(interfaces.GetAddress(sinkNodeId), portNumber);
echoClient.SetAttribute("MaxPackets",

UintegerValue((uint32_t)(m_totalTime * (1 / m_packetInterval))));
echoClient.SetAttribute("Interval", TimeValue(Seconds(m_packetInterval)));
echoClient.SetAttribute("PacketSize", UintegerValue(m_packetSize));
ApplicationContainer clientApps = echoClient.Install(nodes.Get(0));
Ptr<UdpEchoClient> app = clientApps.Get(0)->GetObject<UdpEchoClient>();
app->TraceConnectWithoutContext("Tx", MakeCallback(&TxTrace));
app->TraceConnectWithoutContext("Rx", MakeCallback(&RxTrace));
clientApps.Start(Seconds(1.0));
```

```
clientApps.Stop(Seconds(m_totalTime + 1.5));
}
int
MeshTest::Run()
{
CreateNodes();
InstallInternetStack();
InstallApplication();
Simulator::Schedule(Seconds(m_totalTime), &MeshTest::Report, this);
Simulator::Stop(Seconds(m_totalTime + 2));
Simulator::Run();
Simulator::Destroy();
std::cout << "UDP echo packets sent: " << g_udpTxCount << " received: " <<
g_udpRxCount
<< std::endl;
return 0;
}
void
MeshTest::Report()
{
unsigned n(0);
for (NetDeviceContainer::Iterator i = meshDevices.Begin(); i != meshDevices.End(); ++i,
++n)
{
std::ostringstream os;
os<< "mp-report-" << n << ".xml";
std::cerr << "Printing mesh point device #" << n <<" diagnostics to " << os.str() << "\n";
std::ofstream of;
of.open(os.str().c_str());
if (!of.is_open())
{
std::cerr << "Error: Can't open file " <<os.str() << "\n";
return;
}
mesh.Report(*i, of);
of.close();

}
}
int
main(int argc, char* argv[])
{
MeshTest t;
t.Configure(argc, argv);
return t.Run();
}
```

Output:

```
[  0%] Building CXX object scratch/CMakeFiles/scratch_practical7.dir/practical7.cc.o
[  0%] Linking CXX executable ../../build/scratch/ns3.36.1-practical7-default
At time +2s client sent 1024 bytes to 10.1.2.6 port 9
At time +2.00596s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00596s server sent 1024 bytes to 10.1.1.1 port 49153
At time +2.01192s client received 1024 bytes from 10.1.2.6 port 9
lab2-42@lab242-B250M-D2V:~/Desktop/saurabh_92/ns-allinone-3.36.1/ns-3.36.1$ ./ns3 run scratch/practical7 -- vis
Consolidate compiler generated dependencies of target scratch_practical7
At time +2s client sent 1024 bytes to 10.1.2.6 port 9
At time +2.00596s server received 1024 bytes from 10.1.1.1 port 49153
At time +2.00596s server sent 1024 bytes to 10.1.1.1 port 49153
At time +2.01192s client received 1024 bytes from 10.1.2.6 port 9
lab2-42@lab242-B250M-D2V:~/Desktop/saurabh_92/ns-allinone-3.36.1/ns-3.36.1$
```

```
lab2-@lab2-B250M-D2V:~/Desktop/ns-allinone-3.36.1/ns-3.36.1$ cd ..
lab2-@lab2-B250M-D2V:~/Desktop/ns-allinone-3.36.1$ cd netanim-3.108/
lab2-@lab2-B250M-D2V:~/Desktop/ns-allinone-3.36.1/netanim-3.108$ ./NetAnim
Warning: Ignoring XDG_SESSION_TYPE=wayland on Gnome. Use QT_QPA_PLATFORM=wayland to run on Wayland anyway.
Segmentation fault (core dumped)
```

Practical No: 8

Aim: Program to simulate hybrid topology

Code:
hybrid.cc

```
#include "ns3/core-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/network-module.h"
#include "ns3/applications-module.h"
#include "ns3/mobility-module.h"
#include "ns3/csma-module.h"
#include "ns3/internet-module.h"
#include "ns3/yans-wifi-helper.h"
#include "ns3/ssid.h"
// Default Network Topology
//
// Wifi 10.1.3.0
// AP
// * * * *
// | | | | 10.1.1.0
// n5 n6 n7 n0 ---------------n1 n2 n3 n4
// point-to-point | | | |
// ================
// LAN 10.1.2.0
using namespace ns3;
NS_LOG_COMPONENT_DEFINE ("ThirdScriptExample");
int
main (int argc, char *argv[])
{
bool verbose = true;
uint32_t nCsma = 3;
uint32_t nWifi = 3;
bool tracing = false;
CommandLine cmd (__FILE__);
cmd.AddValue ("nCsma", "Number of \"extra\" CSMA nodes/devices", nCsma);
cmd.AddValue ("nWifi", "Number of wifi STA devices", nWifi);
cmd.AddValue ("verbose", "Tell echo applications to log if true", verbose);
cmd.AddValue ("tracing", "Enable pcap tracing", tracing);

cmd.Parse (argc,argv);
// The underlying restriction of 18 is due to the grid position
// allocator's configuration; the grid layout will exceed the
// bounding box if more than 18 nodes are provided.
if (nWifi > 18)
{
std::cout << "nWifi should be 18 or less; otherwise grid layout exceeds the bounding box" <<
std::endl;
return 1;
```

```
}
if (verbose)
{
LogComponentEnable ("UdpEchoClientApplication", LOG_LEVEL_INFO);
LogComponentEnable ("UdpEchoServerApplication", LOG_LEVEL_INFO);
}
NodeContainer p2pNodes;
p2pNodes.Create (2);
PointToPointHelper pointToPoint;
pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));
NetDeviceContainer p2pDevices;
p2pDevices = pointToPoint.Install (p2pNodes);
NodeContainer csmaNodes;
csmaNodes.Add (p2pNodes.Get (1));
csmaNodes.Create (nCsma);
CsmaHelper csma;
csma.SetChannelAttribute ("DataRate", StringValue ("100Mbps"));
csma.SetChannelAttribute ("Delay", TimeValue (NanoSeconds (6560)));
NetDeviceContainer csmaDevices;
csmaDevices = csma.Install (csmaNodes);
NodeContainer wifiStaNodes;
wifiStaNodes.Create (nWifi);
NodeContainer wifiApNode = p2pNodes.Get (0);
YansWifiChannelHelper channel = YansWifiChannelHelper::Default ();
YansWifiPhyHelper phy;
phy.SetChannel (channel.Create ());
WifiMacHelper mac;
Ssid ssid = Ssid ("ns-3-ssid");
WifiHelper wifi;
NetDeviceContainer staDevices;
mac.SetType ("ns3::StaWifiMac",
"Ssid", SsidValue (ssid),
"ActiveProbing", BooleanValue (false));
staDevices = wifi.Install (phy, mac, wifiStaNodes);

NetDeviceContainer apDevices;
mac.SetType ("ns3::ApWifiMac",
"Ssid", SsidValue (ssid));
apDevices = wifi.Install (phy, mac, wifiApNode);
MobilityHelper mobility;
mobility.SetPositionAllocator ("ns3::GridPositionAllocator",
"MinX", DoubleValue (0.0),
"MinY", DoubleValue (0.0),
"DeltaX", DoubleValue (5.0),
"DeltaY", DoubleValue (10.0),
"GridWidth", UintegerValue (3),
"LayoutType", StringValue ("RowFirst"));
mobility.SetMobilityModel ("ns3::RandomWalk2dMobilityModel",
"Bounds", RectangleValue (Rectangle (-50, 50, -50, 50)));
```

```
mobility.Install (wifiStaNodes);
mobility.SetMobilityModel ("ns3::ConstantPositionMobilityModel");
mobility.Install (wifiApNode);
InternetStackHelper stack;
stack.Install (csmaNodes);
stack.Install (wifiApNode);
stack.Install (wifiStaNodes);
Ipv4AddressHelper address;
address.SetBase ("10.1.1.0", "255.255.255.0");
Ipv4InterfaceContainer p2pInterfaces;
p2pInterfaces = address.Assign (p2pDevices);
address.SetBase ("10.1.2.0", "255.255.255.0");
Ipv4InterfaceContainer csmaInterfaces;
csmaInterfaces = address.Assign (csmaDevices);
address.SetBase ("10.1.3.0", "255.255.255.0");
address.Assign (staDevices);
address.Assign (apDevices);
UdpEchoServerHelper echoServer (9);
ApplicationContainer serverApps = echoServer.Install (csmaNodes.Get (nCsma));
serverApps.Start (Seconds (1.0));
serverApps.Stop (Seconds (10.0));
UdpEchoClientHelper echoClient (csmaInterfaces.GetAddress (nCsma), 9);
echoClient.SetAttribute ("MaxPackets", UintegerValue (1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UintegerValue (1024));
ApplicationContainer clientApps =
echoClient.Install (wifiStaNodes.Get (nWifi - 1));
clientApps.Start (Seconds (2.0));
clientApps.Stop (Seconds (10.0));
Ipv4GlobalRoutingHelper::PopulateRoutingTables ();
Simulator::Stop (Seconds (10.0));
if (tracing)
{
phy.SetPcapDataLinkType (WifiPhyHelper::DLT_IEEE802_11_RADIO);
pointToPoint.EnablePcapAll ("third");
phy.EnablePcap ("third", apDevices.Get (0));
csma.EnablePcap ("third", csmaDevices.Get (0), true);
}
Simulator::Run ();
Simulator::Destroy ();
return 0;
}
```

Output:

```
lab2-@lab2-B250M-D2V:~/Desktop/ns-allinone-3.36.1/ns-3.36.1$ ./ns3 run scratch/hybrid
Consolidate compiler generated dependencies of target scratch_hybrid
At time +2s client sent 1024 bytes to 10.1.2.4 port 9
At time +2.01624s server received 1024 bytes from 10.1.3.3 port 49153
At time +2.01624s server sent 1024 bytes to 10.1.3.3 port 49153
At time +2.02849s client received 1024 bytes from 10.1.2.4 port 9
```

Practical No : 9

Aim: Program to simulate UDP Server client.

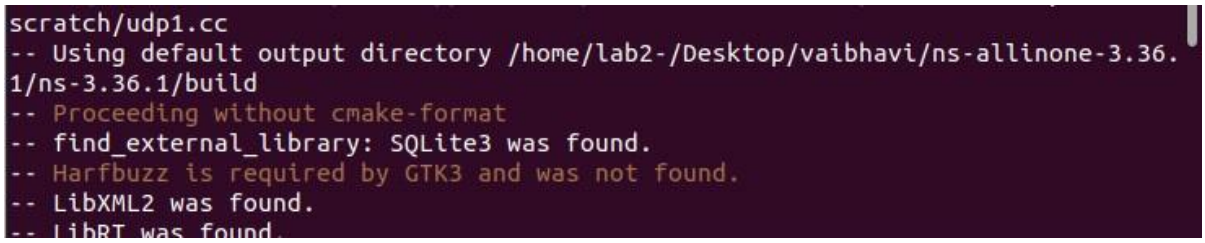
Code:
udp.cc

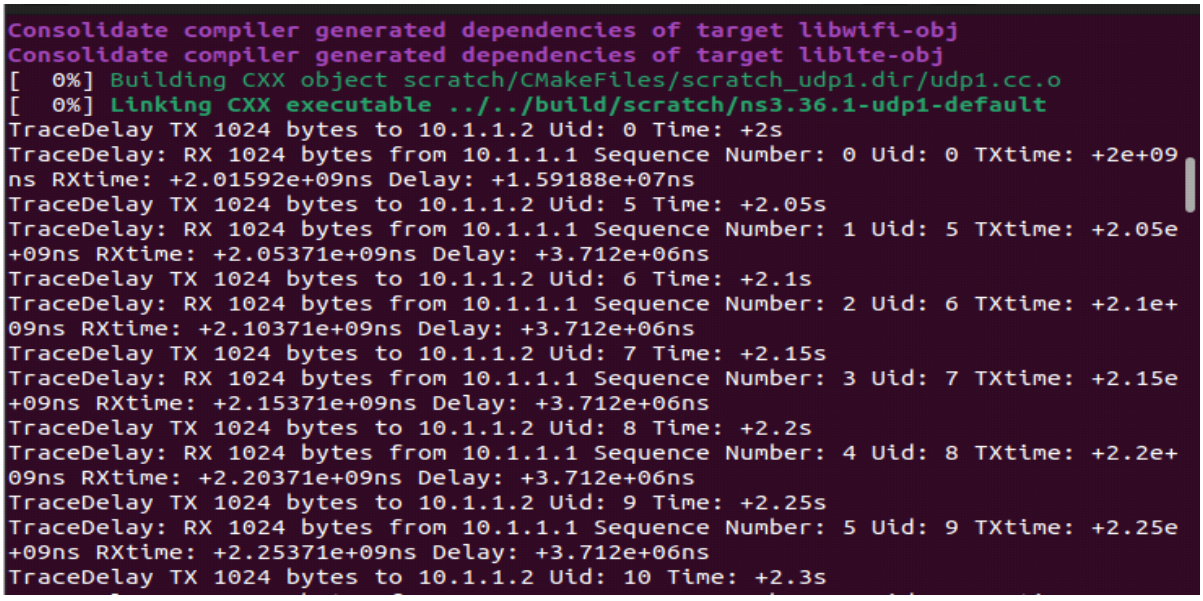
```
#include <fstream>
#include "ns3/core-module.h"
#include "ns3/core-module.h"
#include "ns3/csma-module.h"
#include "ns3/applications-module.h"
#include "ns3/internet-module.h"

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("UdpClientServerExample");

int
main (int argc, char *argv[])
{
//
// Enable logging for UdpClient and
//
  LogComponentEnable ("UdpClient", LOG_LEVEL_INFO);
  LogComponentEnable ("UdpServer", LOG_LEVEL_INFO);

bool useV6 = false;
  Address serverAddress;

  CommandLine cmd;
  cmd.AddValue ("useIpv6", "Use Ipv6", useV6);
  cmd.Parse (argc, argv);

//
// Explicitly create the nodes required by the topology (shown above).
//
  NS_LOG_INFO ("Create nodes.");
  NodeContainer n;
  n.Create (2);

  InternetStackHelper internet;
  internet.Install (n);

  NS_LOG_INFO ("Create channels.");
//
// Explicitly create the channels required by the topology (shown above).
//
  CsmaHelper csma;
  csma.SetChannelAttribute ("DataRate", DataRateValue (DataRate (5000000)));
```

```
  csma.SetChannelAttribute ("Delay", TimeValue (MilliSeconds (2)));
  csma.SetDeviceAttribute ("Mtu", UintegerValue (1400));
  NetDeviceContainer d = csma.Install (n);

//
// We've got the "hardware" in place.  Now we need to add IP addresses.
//
  NS_LOG_INFO ("Assign IP Addresses.");
if (useV6 == false)
    {
      Ipv4AddressHelper ipv4;
      ipv4.SetBase ("10.1.1.0", "255.255.255.0");
      Ipv4InterfaceContainer i = ipv4.Assign (d);
serverAddress = Address (i.GetAddress (1));
    }
 else
    {
      Ipv6AddressHelper ipv6;
      ipv6.SetBase ("2001:0000:f00d:cafe::", Ipv6Prefix (64));
      Ipv6InterfaceContainer i6 = ipv6.Assign (d);
serverAddress = Address(i6.GetAddress (1,1));
    }

  NS_LOG_INFO ("Create Applications.");
//
// Create one udpServer applications on node one.
//
uint16_t port = 4000;
  UdpServerHelper server (port);
  ApplicationContainer apps = server.Install (n.Get (1));
  apps.Start (Seconds (1.0));
   apps.Stop (Seconds (10.0));

 //
 // Create one UdpClient application to send UDP datagrams from node zero to
 // node one.
 //
uint32_t MaxPacketSize = 1024;
   Time interPacketInterval = Seconds (0.05);
uint32_t maxPacketCount = 320;
   UdpClientHelper client (serverAddress, port);
   client.SetAttribute ("MaxPackets", UintegerValue (maxPacketCount));
   client.SetAttribute ("Interval", TimeValue (interPacketInterval));
   client.SetAttribute ("PacketSize", UintegerValue (MaxPacketSize));
apps = client.Install (n.Get (0));
    apps.Start (Seconds (2.0));
   apps.Stop (Seconds (10.0));

 //
 // Now, do the actual simulation.
```

```
//
  NS_LOG_INFO ("Run Simulation.");
  Simulator::Run ();
  Simulator::Destroy ();
  NS_LOG_INFO ("Done.");
}
```

Output:





Practical No: 10

Aim: Program to simulate DHCP server and n clients.

Code:

```
#include "ns3/core-module.h"
#include "ns3/internet-apps-module.h"
#include "ns3/csma-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/applications-module.h"
using namespace ns3;
NS_LOG_COMPONENT_DEFINE ("DhcpExample");
int main (int argc, char *argv[])
{
CommandLine cmd (_FILE_);
bool verbose = true;
bool tracing = false;
cmd.AddValue ("verbose", "turn on the logs", verbose);
cmd.AddValue ("tracing", "turn on the tracing", tracing);
cmd.Parse (argc, argv);
// GlobalValue::Bind ("ChecksumEnabled", BooleanValue (true));
if (verbose)
{
LogComponentEnable ("DhcpServer", LOG_LEVEL_ALL);
LogComponentEnable ("DhcpClient", LOG_LEVEL_ALL);
LogComponentEnable ("UdpEchoServerApplication", LOG_LEVEL_INFO);
LogComponentEnable ("UdpEchoClientApplication", LOG_LEVEL_INFO);
}
Time stopTime = Seconds (20);
NS_LOG_INFO ("Create nodes.");
```

```
NodeContainer nodes;
NodeContainer router;
nodes.Create (3);
router.Create (2);
NodeContainer net (nodes, router);
NS_LOG_INFO ("Create channels.");
CsmaHelper csma;
csma.SetChannelAttribute ("DataRate", StringValue ("5Mbps"));
csma.SetChannelAttribute ("Delay", StringValue ("2ms"));
csma.SetDeviceAttribute ("Mtu", UintegerValue (1500));
NetDeviceContainer devNet = csma.Install (net);
NodeContainer p2pNodes;
p2pNodes.Add (net.Get (4));
p2pNodes.Create (1);
PointToPointHelper pointToPoint;
pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));
NetDeviceContainer p2pDevices;
p2pDevices = pointToPoint.Install (p2pNodes);
InternetStackHelper tcpip;
tcpip.Install (nodes);
tcpip.Install (router);
tcpip.Install (p2pNodes.Get (1));
Ipv4AddressHelper address;
address.SetBase ("172.30.1.0", "255.255.255.0");
Ipv4InterfaceContainer p2pInterfaces;
p2pInterfaces = address.Assign (p2pDevices);
// manually add a routing entry because we don't want to add a dynamic routing
Ipv4StaticRoutingHelper ipv4RoutingHelper;
```

```
Ptr<Ipv4> ipv4Ptr = p2pNodes.Get (1)->GetObject<Ipv4> ();

Ptr<Ipv4StaticRouting> staticRoutingA = ipv4RoutingHelper.GetStaticRouting (ipv4Ptr);

staticRoutingA->AddNetworkRouteTo (Ipv4Address ("172.30.0.0"), Ipv4Mask ("/24"),

Ipv4Address ("172.30.1.1"), 1);

NS_LOG_INFO ("Setup the IP addresses and create DHCP applications.");

DhcpHelper dhcpHelper;

// The router must have a fixed IP.

Ipv4InterfaceContainer fixedNodes = dhcpHelper.InstallFixedAddress (devNet.Get (4),
Ipv4Address ("172.30.0.17"), Ipv4Mask ("/24"));

// Not really necessary, IP forwarding is enabled by default in IPv4.

fixedNodes.Get (0).first->SetAttribute ("IpForward", BooleanValue (true));

// DHCP server

ApplicationContainer dhcpServerApp = dhcpHelper.InstallDhcpServer (devNet.Get (3),
Ipv4Address ("172.30.0.12"),

Ipv4Address ("172.30.0.0"), Ipv4Mask ("/24"),

Ipv4Address ("172.30.0.10"), Ipv4Address ("172.30.0.15"),

Ipv4Address ("172.30.0.17"));

// This is just to show how it can be done.

DynamicCast<DhcpServer> (dhcpServerApp.Get (0))->AddStaticDhcpEntry (devNet.Get
(2)->GetAddress (), Ipv4Address ("172.30.0.14"));

dhcpServerApp.Start (Seconds (0.0));

dhcpServerApp.Stop (stopTime);

// DHCP clients

NetDeviceContainer dhcpClientNetDevs;

dhcpClientNetDevs.Add (devNet.Get (0));

dhcpClientNetDevs.Add (devNet.Get (1));

dhcpClientNetDevs.Add (devNet.Get (2));

ApplicationContainer dhcpClients = dhcpHelper.InstallDhcpClient (dhcpClientNetDevs);

dhcpClients.Start (Seconds (1.0));

dhcpClients.Stop (stopTime);

UdpEchoServerHelper echoServer (9);
```

```
ApplicationContainer serverApps = echoServer.Install (p2pNodes.Get (1));
serverApps.Start (Seconds (0.0));
serverApps.Stop (stopTime);
UdpEchoClientHelper echoClient (p2pInterfaces.GetAddress (1), 9);
echoClient.SetAttribute ("MaxPackets", UintegerValue (100));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UintegerValue (1024));
ApplicationContainer clientApps = echoClient.Install (nodes.Get (1));
clientApps.Start (Seconds (10.0));
clientApps.Stop (stopTime);
Simulator::Stop (stopTime + Seconds (10.0));
if (tracing)
{
csma.EnablePcapAll ("dhcp-csma");
pointToPoint.EnablePcapAll ("dhcp-p2p");
}
NS_LOG_INFO ("Run Simulation.");
Simulator::Run ();
Simulator::Destroy ();
NS_LOG_INFO ("Done.");
}
```

Output:

```
DhcpClient:NetHandler(0x563a3fd8dff0, 0x563a3fd88cf0)
DhcpClient:AcceptAck(0x563a3fd8dff0, (type=), 04-07-ac:1e:00:0c:43:00:00)
DHCP ACK received
Got a new address (172.30.0.10), removing old one: 0.0.0.0
Current DHCP Server is 172.30.0.12
DhcpClient:NetHandler(0x563a3fd84d30, 0x563a3fd89dc0)
DhcpClient:NetHandler(0x563a3fd85d20, 0x563a3fd8af30)
DhcpClient:Select(0x563a3fd84d30)
DhcpClient:Request(0x563a3fd84d30)
DhcpServer:NetHandler(0x563a3fd59400, 0x563a3fd87fd0)
DhcpServer:SendAck(0x563a3fd59400, 0x563a3fd617f0, (type=), 04-07-00:00:00:00:44:00:00)
DHCP REQUEST from: 0.0.0.0 source port: 68 - refreshed addr: 172.30.0.11
DhcpClient:NetHandler(0x563a3fd8dff0, 0x563a3fd88cf0)
DhcpClient:NetHandler(0x563a3fd84d30, 0x563a3fd89dc0)
DhcpClient:AcceptAck(0x563a3fd84d30, (type=), 04-07-ac:1e:00:0c:43:00:00)
DHCP ACK received
Got a new address (172.30.0.11), removing old one: 0.0.0.0
Current DHCP Server is 172.30.0.12
DhcpClient:NetHandler(0x563a3fd85d20, 0x563a3fd8af30)
DhcpClient:Select(0x563a3fd85d20)
DhcpClient:Request(0x563a3fd85d20)
DhcpServer:NetHandler(0x563a3fd59400, 0x563a3fd87fd0)
DhcpServer:SendAck(0x563a3fd59400, 0x563a3fd617f0, (type=), 04-07-00:00:00:00:44:00:00)
DHCP REQUEST from: 0.0.0.0 source port: 68 - refreshed addr: 172.30.0.14
DhcpClient:NetHandler(0x563a3fd8dff0, 0x563a3fd88cf0)
DhcpClient:NetHandler(0x563a3fd84d30, 0x563a3fd89dc0)
DhcpClient:NetHandler(0x563a3fd85d20, 0x563a3fd8af30)
DhcpClient:AcceptAck(0x563a3fd85d20, (type=), 04-07-ac:1e:00:0c:43:00:00)
DHCP ACK received
Got a new address (172.30.0.14), removing old one: 0.0.0.0
Current DHCP Server is 172.30.0.12
DhcpServer:TimerHandler(0x563a3fd59400)
DhcpServer:TimerHandler(0x563a3fd59400)
DhcpServer:TimerHandler(0x563a3fd59400)
DhcpServer:TimerHandler(0x563a3fd59400)
At time +10s client sent 1024 bytes to 172.30.1.2 port 9
At time +10.0196s server received 1024 bytes from 172.30.0.11 port 49153
At time +10.0196s server sent 1024 bytes to 172.30.0.11 port 49153
```

```
DhcpServer:TimerHandler(0x563a3fd59400)
At time +15s client sent 1024 bytes to 172.30.1.2 port 9
At time +15.0074s server received 1024 bytes from 172.30.0.11 port 49153
At time +15.0074s server sent 1024 bytes to 172.30.0.11 port 49153
At time +15.0148s client received 1024 bytes from 172.30.1.2 port 9
DhcpServer:TimerHandler(0x563a3fd59400)
At time +16s client sent 1024 bytes to 172.30.1.2 port 9
At time +16.0074s server received 1024 bytes from 172.30.0.11 port 49153
At time +16.0074s server sent 1024 bytes to 172.30.0.11 port 49153
At time +16.0148s client received 1024 bytes from 172.30.1.2 port 9
DhcpServer:TimerHandler(0x563a3fd59400)
At time +17s client sent 1024 bytes to 172.30.1.2 port 9
At time +17.0074s server received 1024 bytes from 172.30.0.11 port 49153
At time +17.0074s server sent 1024 bytes to 172.30.0.11 port 49153
At time +17.0148s client received 1024 bytes from 172.30.1.2 port 9
DhcpServer:TimerHandler(0x563a3fd59400)
At time +18s client sent 1024 bytes to 172.30.1.2 port 9
At time +18.0074s server received 1024 bytes from 172.30.0.11 port 49153
At time +18.0074s server sent 1024 bytes to 172.30.0.11 port 49153
At time +18.0148s client received 1024 bytes from 172.30.1.2 port 9
DhcpServer:TimerHandler(0x563a3fd59400)
At time +19s client sent 1024 bytes to 172.30.1.2 port 9
At time +19.0074s server received 1024 bytes from 172.30.0.11 port 49153
At time +19.0074s server sent 1024 bytes to 172.30.0.11 port 49153
At time +19.0148s client received 1024 bytes from 172.30.1.2 port 9
DhcpClient:StopApplication(0x563a3fd8dff0)
DhcpClient:StopApplication(0x563a3fd84d30)
DhcpClient:StopApplication(0x563a3fd85d20)
DhcpServer:StopApplication(0x563a3fd59400)
DhcpClient:DoDispose(0x563a3fd8dff0)
DhcpClient:DoDispose(0x563a3fd84d30)
DhcpClient:DoDispose(0x563a3fd85d20)
DhcpServer:DoDispose(0x563a3fd59400)
DhcpClient:~DhcpClient(0x563a3fd8dff0)
DhcpClient:~DhcpClient(0x563a3fd84d30)
DhcpClient:~DhcpClient(0x563a3fd85d20)
DhcpServer:~DhcpServer(0x563a3fd59400)
lab2-43@lab243-B250M-D2V:~/Downloads/ns-allinone-3.36.1/ns-3.36.1$
```

Practical No : 11

Aim: Program to simulate FTP using TCP protocol

Code:

ftp.cc

```
#include <string>
#include <fstream>
#include "ns3/core-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/internet-module.h"
#include "ns3/applications-module.h"
#include "ns3/network-module.h"
#include "ns3/packet-sink.h"

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("TcpBulkSendExample");

int
main (int argc, char *argv[])
{

bool tracing = false;
uint32_t maxBytes = 0;

//
// Allow the user to override any of the defaults at
// run-time, via command-line arguments
//
  CommandLine cmd;
  cmd.AddValue ("tracing", "Flag to enable/disable tracing", tracing);
  cmd.AddValue ("maxBytes",
                "Total number of bytes for application to send", maxBytes);
 cmd.Parse (argc, argv);

//
// Explicitly create the nodes required by the topology (shown above).
//
  NS_LOG_INFO ("Create nodes.");
  NodeContainer nodes;
  nodes.Create (2);

  NS_LOG_INFO ("Create channels.");

//
// Explicitly create the point-to-point link required by the topology (shown above).
//
  PointToPointHelper pointToPoint;
```

```
      pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("500Kbps"));
      pointToPoint.SetChannelAttribute ("Delay", StringValue ("5ms"));

      NetDeviceContainer devices;
devices = pointToPoint.Install (nodes);

    //
    // Install the internet stack on the nodes
    //
      InternetStackHelper internet;
      internet.Install (nodes);

    //
    // We've got the "hardware" in place.  Now we need to add IP addresses.
    //
      NS_LOG_INFO ("Assign IP Addresses.");
      Ipv4AddressHelper ipv4;
      ipv4.SetBase ("10.1.1.0", "255.255.255.0");
      Ipv4InterfaceContainer i = ipv4.Assign (devices);

      NS_LOG_INFO ("Create Applications.");

    //
    // Create a BulkSendApplication and install it on node 0
    //
uint16_t port = 9;  // well-known echo port number


      BulkSendHelper source ("ns3::TcpSocketFactory",
                         InetSocketAddress (i.GetAddress (1), port));
     // Set the amount of data to send in bytes.  Zero is unlimited.
     source.SetAttribute ("MaxBytes", UintegerValue (maxBytes));
     ApplicationContainer sourceApps = source.Install (nodes.Get (0));
     sourceApps.Start (Seconds (0.0));
     sourceApps.Stop (Seconds (10.0));

   //
   // Create a PacketSinkApplication and install it on node 1
   //
     PacketSinkHelper sink ("ns3::TcpSocketFactory",
                        InetSocketAddress (Ipv4Address::GetAny (), port));
     ApplicationContainer sinkApps = sink.Install (nodes.Get (1));
     sinkApps.Start (Seconds (0.0));
     sinkApps.Stop (Seconds (10.0));

   //
   // Set up tracing if enabled
   //
if (tracing)
       {
```

```
    AsciiTraceHelper ascii;
    pointToPoint.EnableAsciiAll (ascii.CreateFileStream ("tcp-bulk-send.tr"));
    pointToPoint.EnablePcapAll ("tcp-bulk-send", false);
   }

//
// Now, do the actual simulation.
//
  NS_LOG_INFO ("Run Simulation.");
  Simulator::Stop (Seconds (10.0));
  Simulator::Run ();
  Simulator::Destroy ();
  NS_LOG_INFO ("Done.");

  Ptr<PacketSink> sink1 = DynamicCast<PacketSink> (sinkApps.Get (0));
  std::cout << "Total Bytes Received: " << sink1->GetTotalRx () << std::endl;
}
```

Output:

```
lab2-52@lab252-B250M-D2V:~/Desktop/ns-allinone-3.36.1/ns-3.36.1$ ./ns3 run scratch/ftp
-- Using default output directory /home/lab2-52/Desktop/ns-allinone-3.36.1/ns-3.36.1/build
-- Proceeding without cmake-format
-- find_external_library: SQLite3 was found.
-- Harfbuzz is required by GTK3 and was not found.
-- LibXML2 was found.
-- LibRT was found.
-- Visualizer requires Python bindings
Total Bytes Received: 553152
lab2-52@lab252-B250M-D2V:~/Desktop/ns-allinone-3.36.1/ns-3.36.1$ ./ns3 run scratch/ftp
Consolidate compiler generated dependencies of target scratch_ftp
Total Bytes Received: 553152
lab2-52@lab252-B250M-D2V:~/Desktop/ns-allinone-3.36.1/ns-3.36.1$
```

Practical No: 12

Aim: Animate a simple network using Net Anim in Network Simulator.

Code:

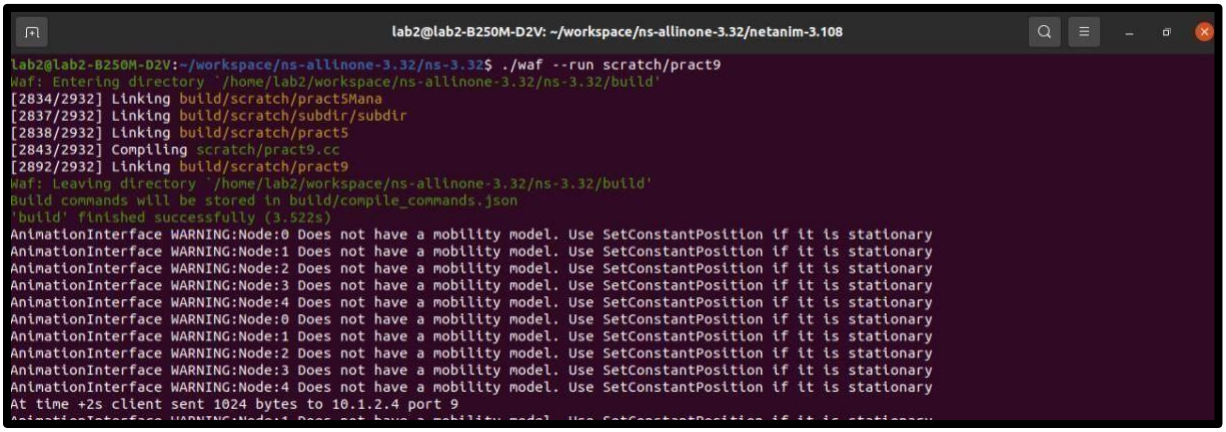
```
#include "ns3/coremodule.h"

#include "ns3/network-module.h"

#include "ns3/csmamodule.h"

#include "ns3/internet-module.h"

#include "ns3/point-to-pointmodule.h"

#include "ns3/applications-module.h"

#include "ns3/ipv4-globalrouting-helper.h"

//Inculding Header File

#include "ns3/netanim-module.h"

// Default Network Topology

//

// 10.1.1.0 // n0 ---------- n1 n2 n3 n4

// point-to-point | | | |

// ================

// LAN 10.1.2.0

using namespace ns3;

NS_LOG_COMPONENT_DEFINE ("SecondScriptExample");

int main (int argc, char *argv[])

{ bool verbose = true;

uint32_t nCsma = 3;

CommandLine cmd ( FILE );

cmd.AddValue ("nCsma", "Number of \"extra\" CSMA nodes/devices",
nCsma);cmd.AddValue ("verbose", "Tell echo applications to log if true", verbose);
```

```
cmd.Parse (argc,argv);
if (verbose)

{

 LogComponentEnable ("UdpEchoClientApplication",
LOG_LEVEL_INFO);LogComponentEnable

("UdpEchoServerApplication", LOG_LEVEL_INFO);

}

nCsma = nCsma == 0 ? 1 : nCsma;

NodeContainer p2pNodes;

p2pNodes.Create (2);

NodeContainer csmaNodes;

csmaNodes.Add (p2pNodes.Get (1));

csmaNodes.Create (nCsma);

PointToPointHelper pointToPoint;

 pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));

 NetDeviceContainer p2pDevices;

p2pDevices = pointToPoint.Install (p2pNodes);

CsmaHelper csma;

csma.SetChannelAttribute ("DataRate", StringValue ("100Mbps"));
csma.SetChannelAttribute ("Delay", TimeValue (NanoSeconds (6560)));

 NetDeviceContainer csmaDevices;

csmaDevices = csma.Install (csmaNodes);

InternetStackHelper stack;

stack.Install (p2pNodes.Get (0));

stack.Install (csmaNodes);

 Ipv4AddressHelper address;

 address.SetBase ("10.1.1.0", "255.255.255.0");

 Ipv4InterfaceContainer p2pInterfaces;

 p2pInterfaces = address.Assign (p2pDevices);
```

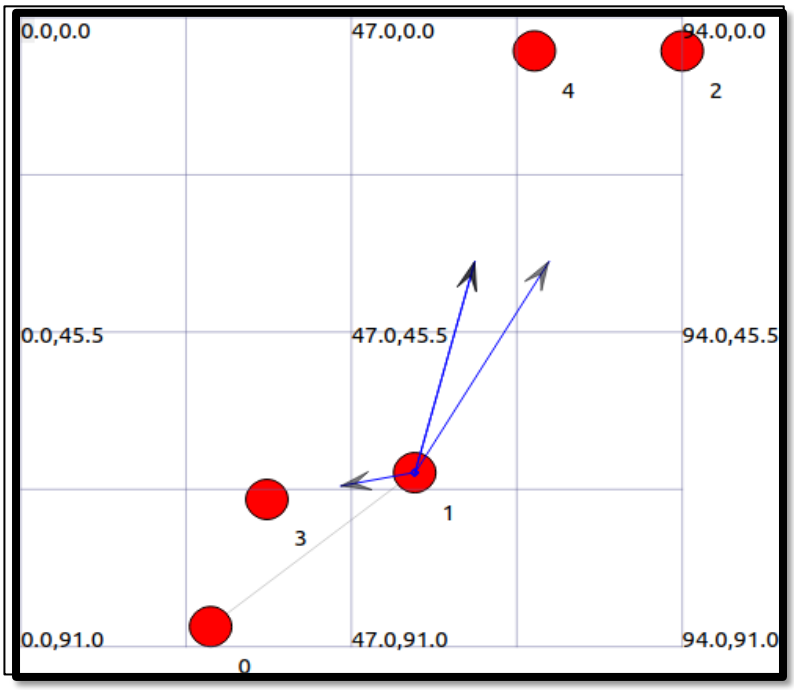
```
address.SetBase ("10.1.2.0", "255.255.255.0");
 Ipv4InterfaceContainer csmaInterfaces;
csmaInterfaces = address.Assign (csmaDevices);
UdpEchoServerHelper echoServer (9);
ApplicationContainer serverApps = echoServer.Install (csmaNodes.Get (nCsma));serverApps.Start (Seconds (1.0));
serverApps.Stop (Seconds (10.0));
 UdpEchoClientHelper echoClient (csmaInterfaces.GetAddress (nCsma), 9);
echoClient.SetAttribute ("MaxPackets", UintegerValue (1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UintegerValue (1024));
ApplicationContainer clientApps = echoClient.Install (p2pNodes.Get (0));
clientApps.Start (Seconds (2.0));
clientApps.Stop (Seconds (10.0));
Ipv4GlobalRouting Helper::PopulateRo utingTables ();
pointToPoint.Enabl ePcapAll ("pract9");
csma.EnablePcap ("pact9", csmaDevices.Get (1), true);
 //Including Animation AnimationInterface
anim("pract9.xml");
 Simulator::Run ();
Simulator::Destroy ();
return 0;
}
```

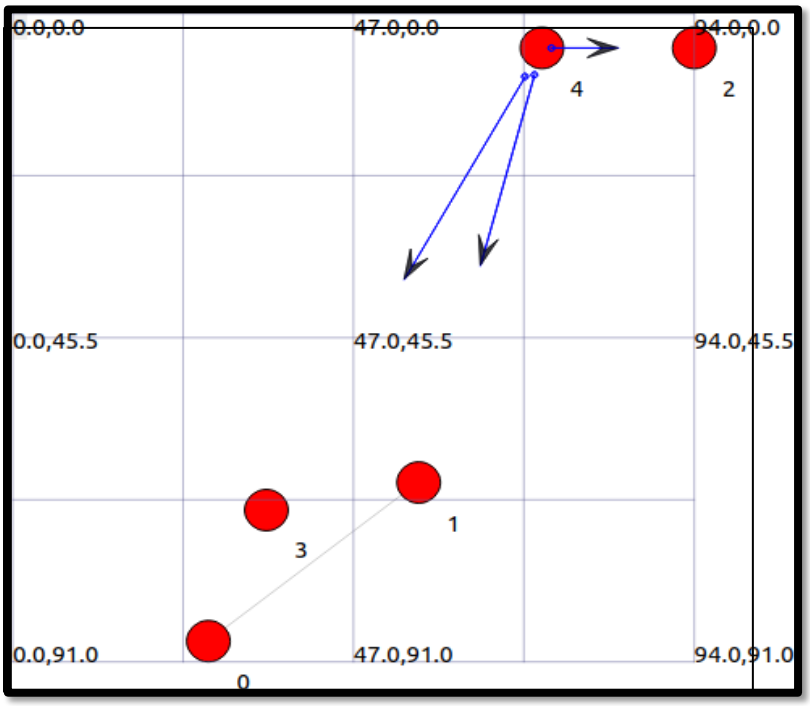
Output:

Running the file and visualizing



```
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32$ ./NetAnim
bash: ./NetAnim: No such file or directory
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/ns-3.32$ cd ..
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32$ cd netanim-3.108
lab2@lab2-B250M-D2V:~/workspace/ns-allinone-3.32/netanim-3.108$ ./NetAnim
```





Practical No: 13

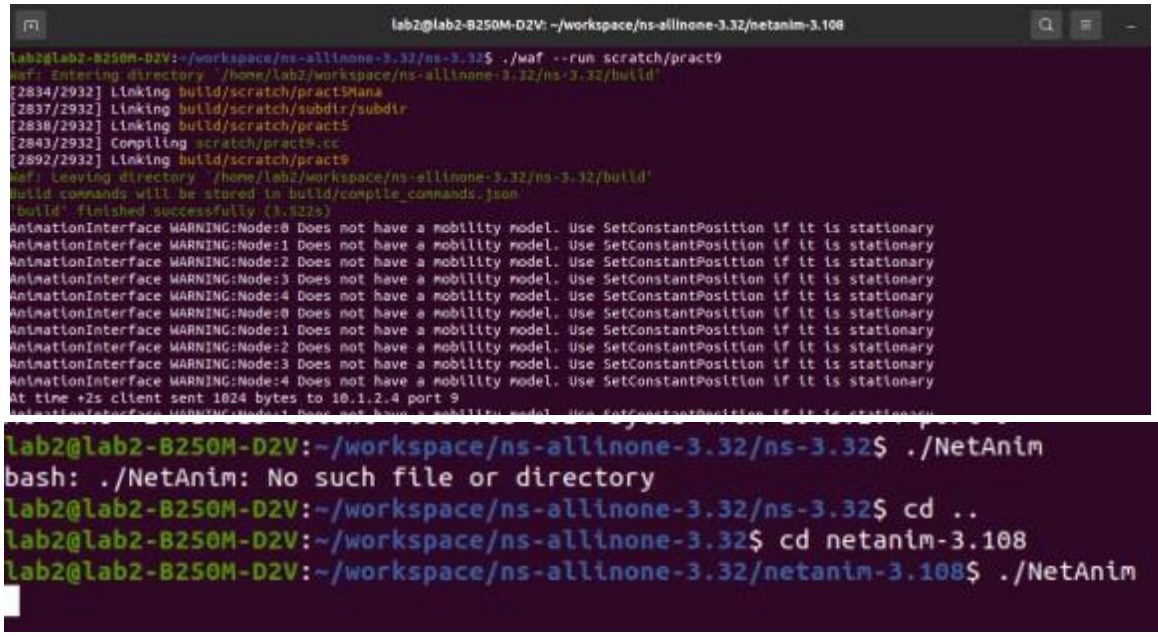
Aim: Animate three-way handshake for TCP Connection using NetAnim.

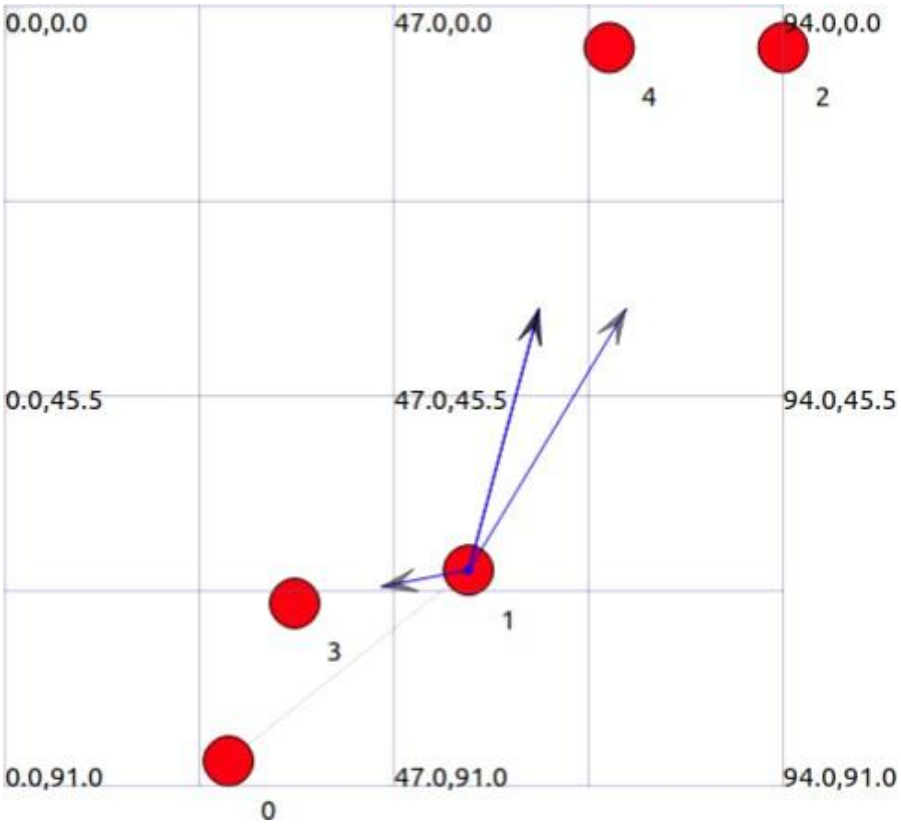
Code:
pract9.cc

```
#include "ns3/core-module.h"
#include "ns3/network-module.h"
#include "ns3/csma-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-module.h"
#include "ns3/applications-module.h"
#include "ns3/ipv4-global-routing-helper.h"
//Inculding Header File
#include "ns3/netanim-module.h"
// Default Network Topology
//
// 10.1.1.0
// n0 ---------- n1 n2 n3 n4
NETWORKING WITH LINUX
// point-to-point | | | |
// ================
// LAN 10.1.2.0
using namespace ns3;
NS_LOG_COMPONENT_DEFINE ("SecondScriptExample");
int
main (int argc, char *argv[])
{
bool verbose = true;
uint32_t nCsma = 3;
CommandLine cmd (__FILE__);
cmd.AddValue ("nCsma", "Number of \"extra\" CSMA nodes/devices", nCsma);
cmd.AddValue ("verbose", "Tell echo applications to log if true", verbose);
cmd.Parse (argc,argv);
if (verbose)
{
LogComponentEnable ("UdpEchoClientApplication", LOG_LEVEL_INFO);
LogComponentEnable ("UdpEchoServerApplication", LOG_LEVEL_INFO);
}
nCsma = nCsma == 0 ? 1 : nCsma;
NodeContainer p2pNodes;
p2pNodes.Create (2);
NodeContainer csmaNodes;
csmaNodes.Add (p2pNodes.Get (1));
csmaNodes.Create (nCsma);
```

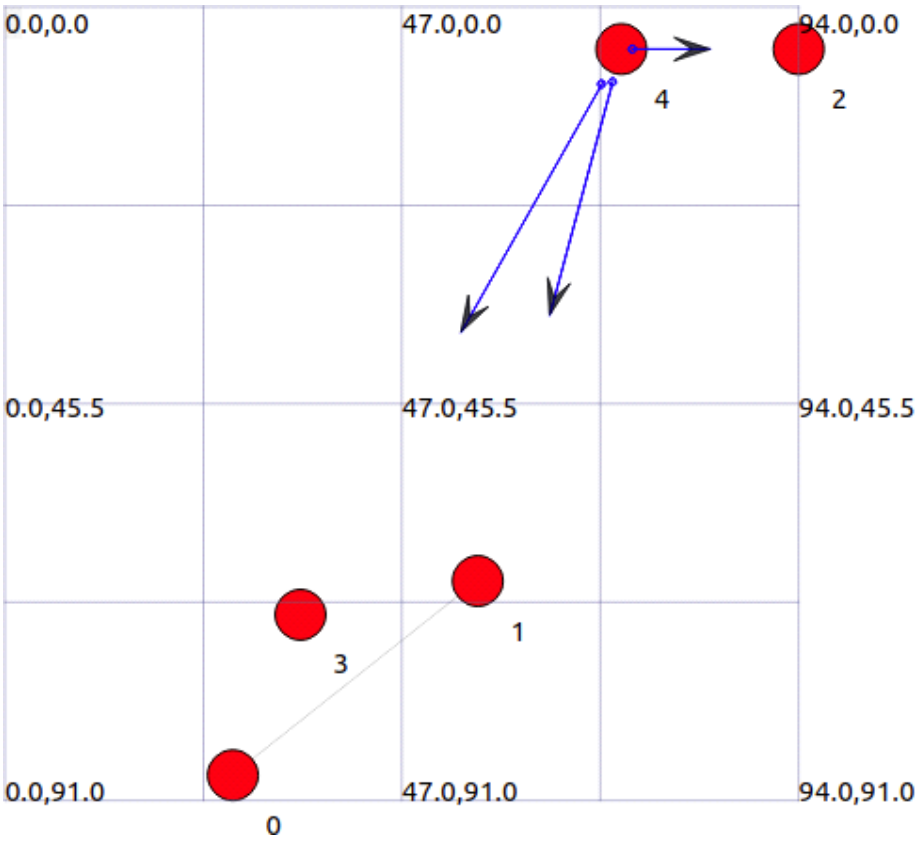
```
PointToPointHelper pointToPoint;
pointToPoint.SetDeviceAttribute ("DataRate", StringValue ("5Mbps"));
pointToPoint.SetChannelAttribute ("Delay", StringValue ("2ms"));
NetDeviceContainer p2pDevices;
p2pDevices = pointToPoint.Install (p2pNodes);
CsmaHelper csma;
csma.SetChannelAttribute ("DataRate", StringValue ("100Mbps"));
csma.SetChannelAttribute ("Delay", TimeValue (NanoSeconds (6560)));
NetDeviceContainer csmaDevices;
csmaDevices = csma.Install (csmaNodes);
InternetStackHelper stack;
stack.Install (p2pNodes.Get (0));
NETWORKING WITH LINUX
stack.Install (csmaNodes);
Ipv4AddressHelper address;
address.SetBase ("10.1.1.0", "255.255.255.0");
Ipv4InterfaceContainer p2pInterfaces;
p2pInterfaces = address.Assign (p2pDevices);
address.SetBase ("10.1.2.0", "255.255.255.0");
Ipv4InterfaceContainer csmaInterfaces;
csmaInterfaces = address.Assign (csmaDevices);
UdpEchoServerHelper echoServer (9);
ApplicationContainer serverApps = echoServer.Install (csmaNodes.Get (nCsma));
serverApps.Start (Seconds (1.0));
serverApps.Stop (Seconds (10.0));
UdpEchoClientHelper echoClient (csmaInterfaces.GetAddress (nCsma), 9);
echoClient.SetAttribute ("MaxPackets", UintegerValue (1));
echoClient.SetAttribute ("Interval", TimeValue (Seconds (1.0)));
echoClient.SetAttribute ("PacketSize", UintegerValue (1024));
ApplicationContainer clientApps = echoClient.Install (p2pNodes.Get (0));
clientApps.Start (Seconds (2.0));
clientApps.Stop (Seconds (10.0));
Ipv4GlobalRoutingHelper::PopulateRoutingTables ();
pointToPoint.EnablePcapAll ("pract9");
csma.EnablePcap ("pact9", csmaDevices.Get (1), true);
//Including Animation
AnimationInterface anim("pract9.xml");
Simulator::Run ();
Simulator::Destroy ();
return 0;
}
```

Output:
Running the file and visualizing it.





ROLL.NO: 101
FYMCA DIV-B



Practical No: 14

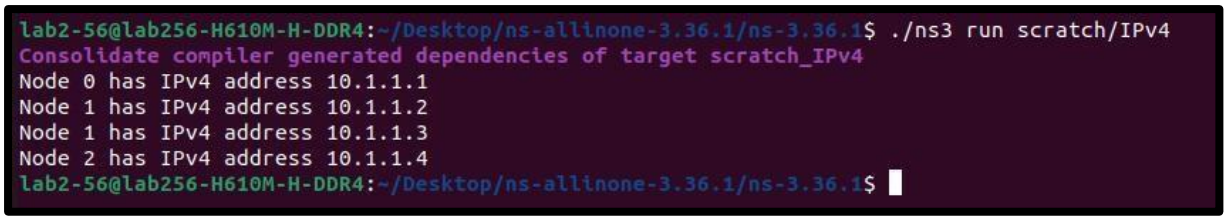
Aim: Program to assign IPv4 Addresses in NS3.

Code:

```
#include "ns3/core-module.h"
#include "ns3/network-module.h"
#include "ns3/internet-module.h"
#include "ns3/point-to-point-module.h"

using namespace ns3;

int main(int argc, char* argv[]) {
  // Create a node container
NodeContainer nodes;
nodes.Create(3);

  // Create two point-to-point helpers
  PointToPointHelper pointToPoint1, pointToPoint2;
pointToPoint1.SetDeviceAttribute("DataRate", StringValue("5Mbps"));
pointToPoint1.SetChannelAttribute("Delay", StringValue("2ms"));
pointToPoint2.SetDeviceAttribute("DataRate", StringValue("5Mbps"));
pointToPoint2.SetChannelAttribute("Delay", StringValue("2ms"));

  // Create two net device containers and install devices
  NetDeviceContainer devices1, devices2;
  devices1 = pointToPoint1.Install(nodes.Get(0), nodes.Get(1));
  devices2 = pointToPoint2.Install(nodes.Get(1), nodes.Get(2));

  // Install Internet stack on nodes
InternetStackHelper internet;
internet.Install(nodes);

  // Assign IP addresses
Ipv4AddressHelper ipv4;
ipv4.SetBase("10.1.1.0", "255.255.255.0");
  Ipv4InterfaceContainer interfaces1 = ipv4.Assign(devices1);
  Ipv4InterfaceContainer interfaces2 = ipv4.Assign(devices2);

  // Print assigned IP addresses
for (uint32_t i = 0; i < interfaces1.GetN(); ++i) {
   std::cout << "Node "<< i << " has IPv4 address " << interfaces1.GetAddress(i) <<
std::endl;
  }
for (uint32_t i = 0; i < interfaces2.GetN(); ++i) {
   std::cout << "Node "<< i+1 << " has IPv4 address " << interfaces2.GetAddress(i) <<
```

```
std::endl;
  }

  Simulator::Run();
  Simulator::Destroy();

return 0;
}
```

Output:

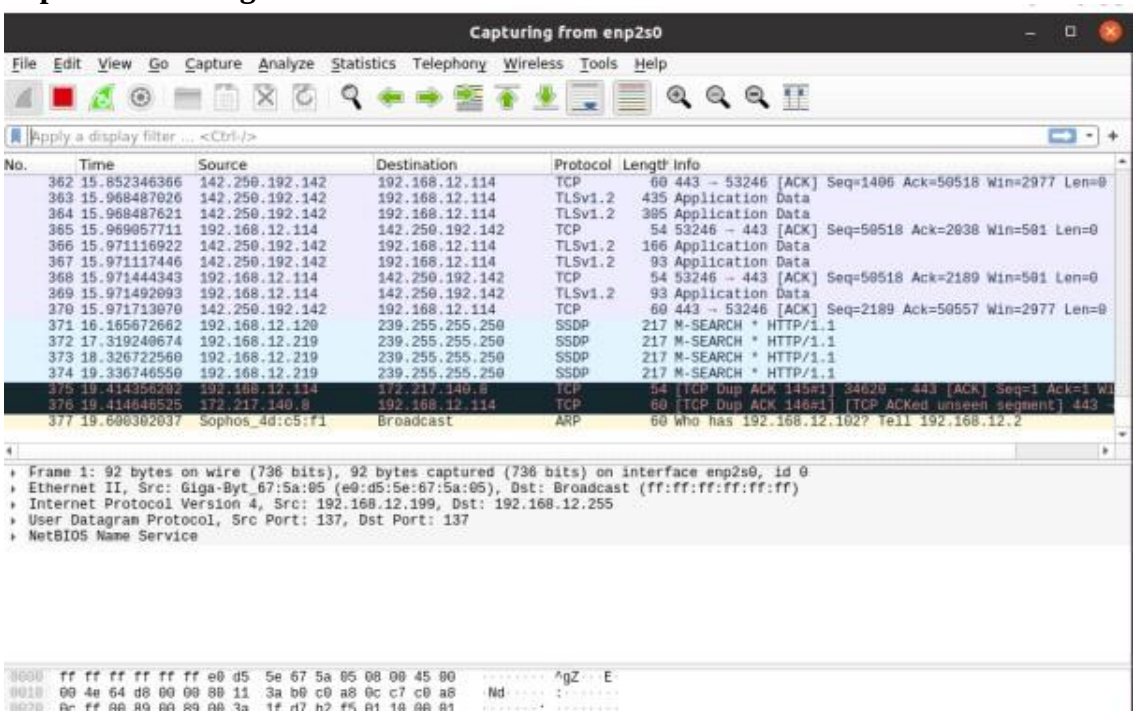


ROLL.NO: 101
FYMCA DIV-B

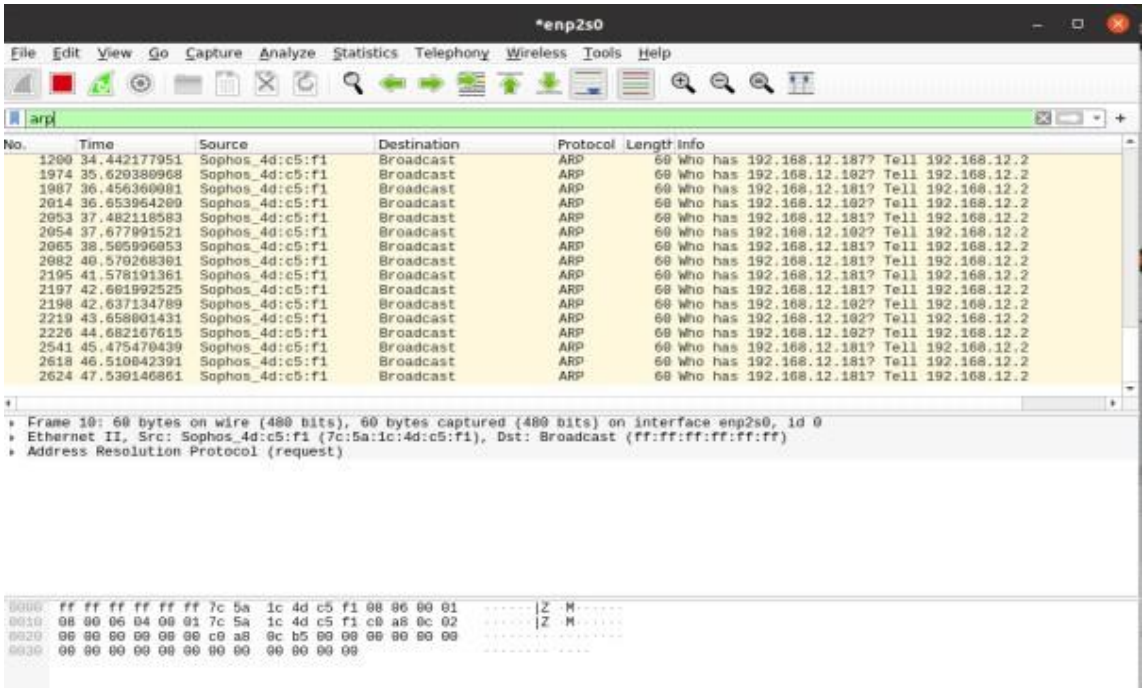
Practical No :15

Aim: Analyze the Network traffic using Wireshark

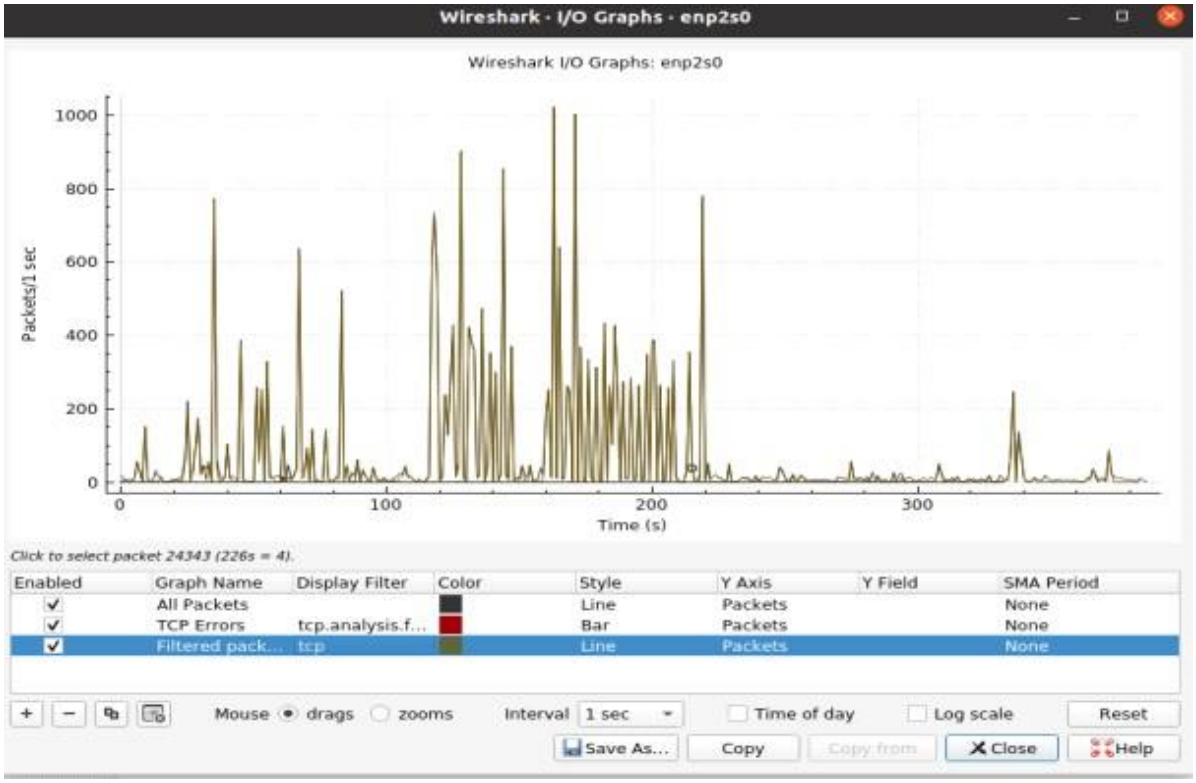
Steps: Considering en2s0 network



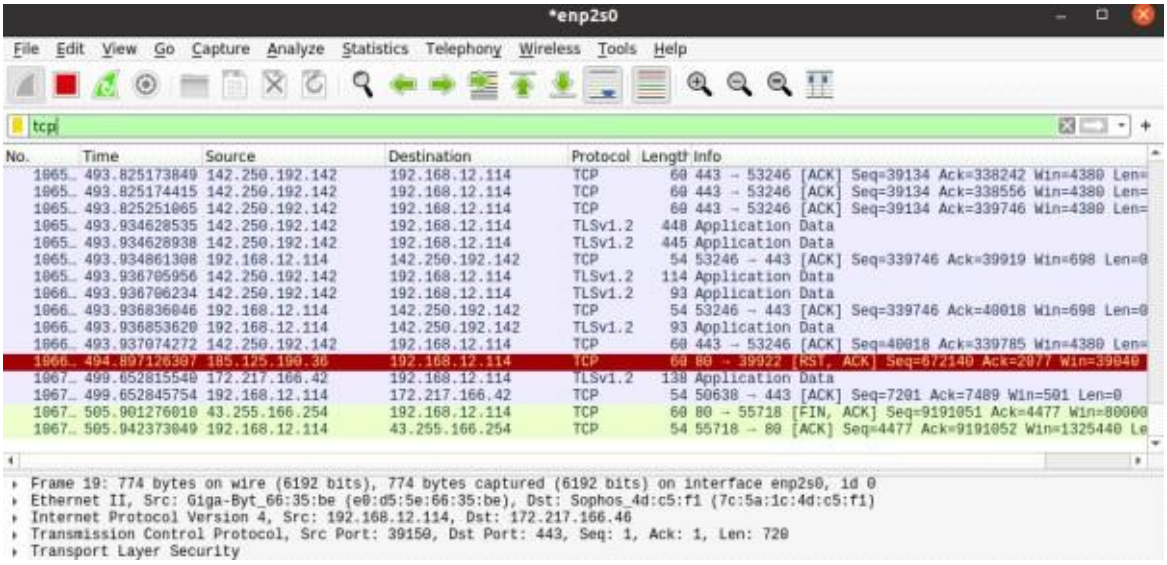
2. ARP



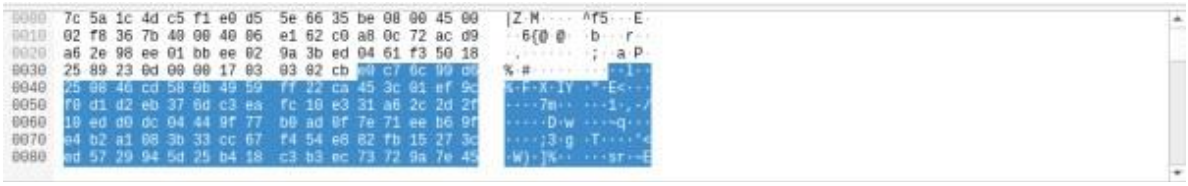
3. Graph


Wireshark · I/O Graphs · enp2s0
Wireshark I/O Graphs: enp2s0
Packets/1 sec
Time (s)
Click to select packet 24343 (226s = 4).
Enabled
Graph Name
Display Filter
Color
Style
Y Axis
Y Field
SMA Period
All Packets
Line
Packets
None
TCP Errors
tcp.analysis.f...
Bar
Packets
None
Filtered pack...
tcp
Line
Packets
None
Mouse drags zooms
Interval 1 sec
Time of day
Log scale
Reset
Save As...
Copy
Copy from
Close
Help

4. TCP


*enp2s0
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp
No. Time Source Destination Protocol Length Info
Frame 19: 774 bytes on wire (6192 bits), 774 bytes captured (6192 bits) on interface enp2s0, id 0
Ethernet II, Src: Giga-Byt_66:35:be (e0:d5:5e:66:35:be), Dst: Sophos_4d:c5:f1 (7c:5a:1c:4d:c5:f1)
Internet Protocol Version 4, Src: 192.168.12.114, Dst: 172.217.166.46
Transmission Control Protocol, Src Port: 39150, Dst Port: 443, Seq: 1, Ack: 1, Len: 720
Transport Layer Security

ROLL.NO: 101
FYMCA DIV-B

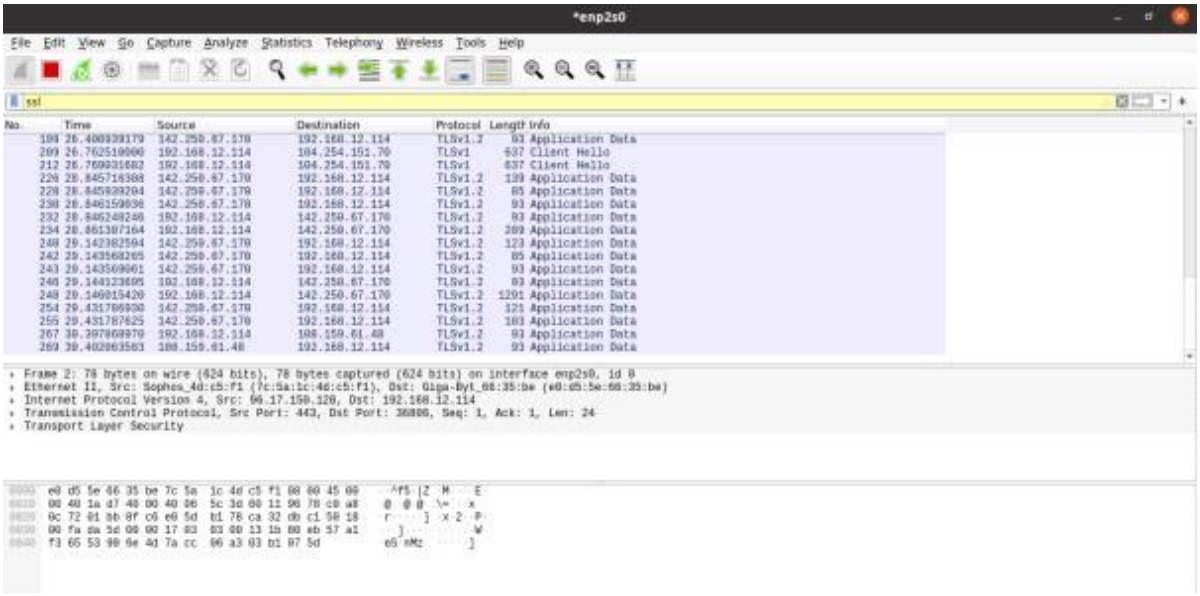


Practical No: 16

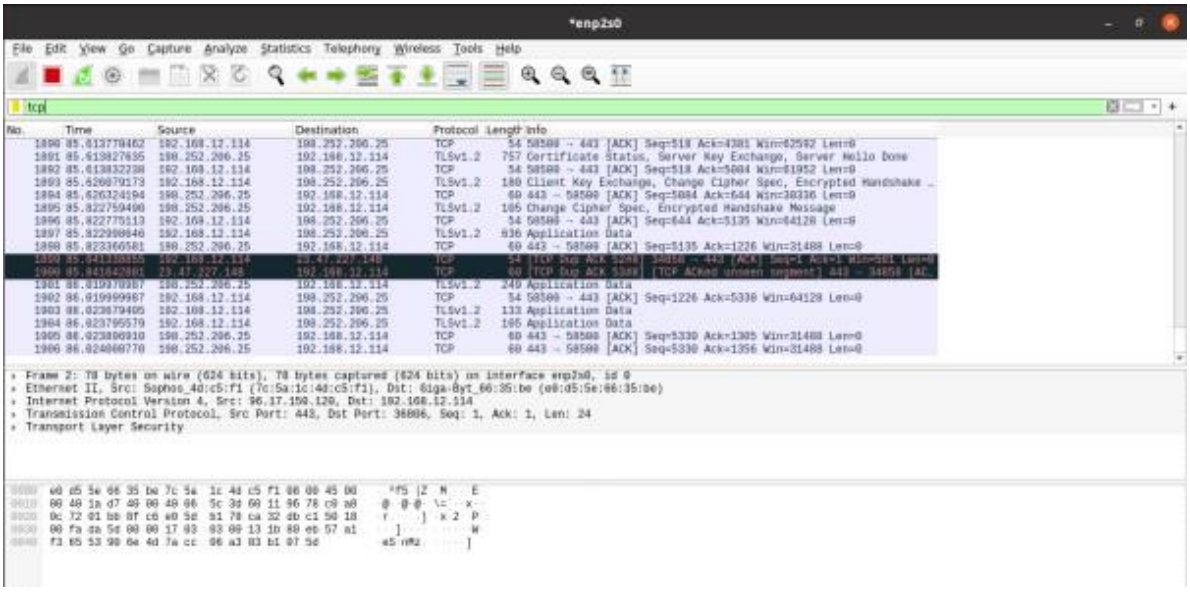
Aim: Analyze the performance parameter of the network using Wireshark.

Steps:

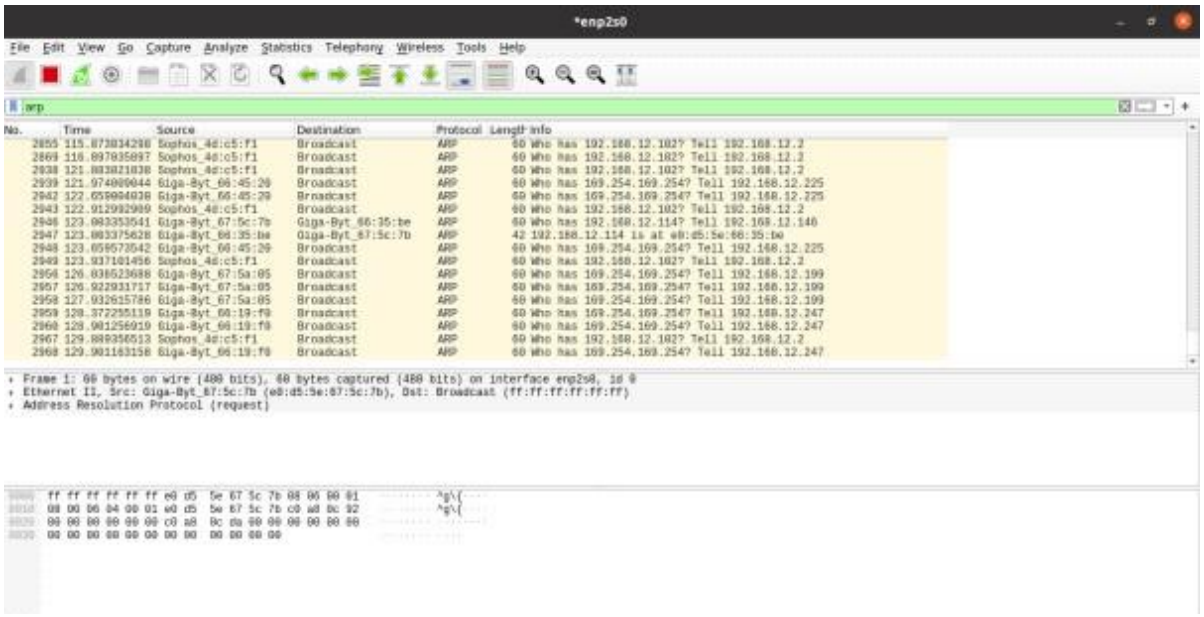
1. SSL



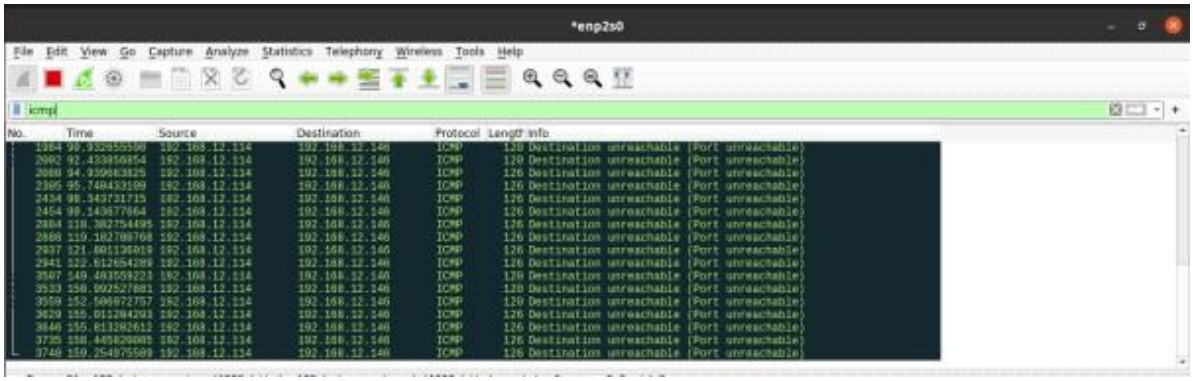
2. TCP

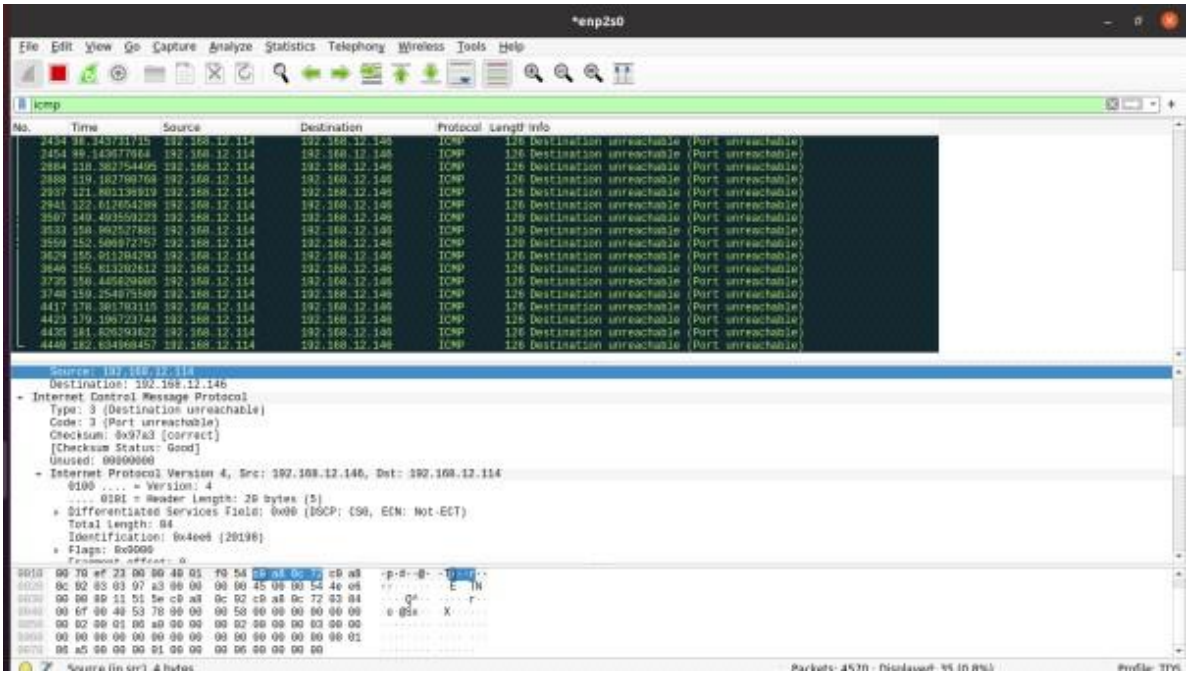


3. ARP

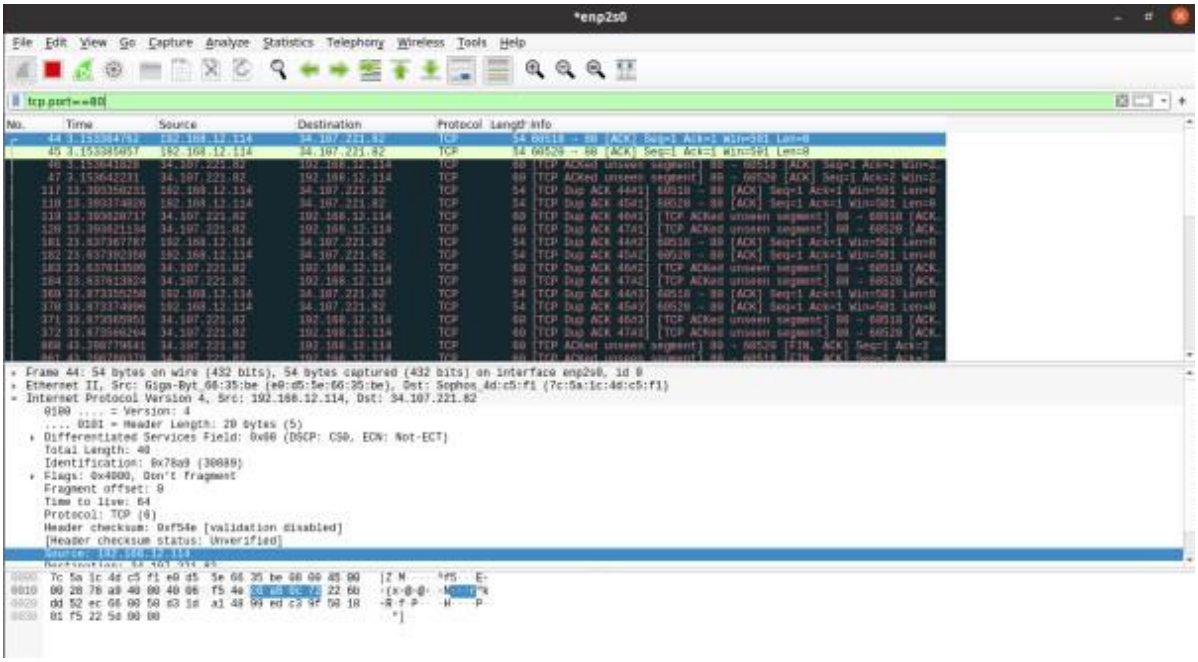

*enp2s0
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
arp
No. Time Source Destination Protocol Length Info
2855 115.873834208 Sophos_4d:c5:f1 Broadcast ARP 60 Who has 192.168.12.102? Tell 192.168.12.2
2869 116.897035097 Sophos_4d:c5:f1 Broadcast ARP 60 Who has 192.168.12.102? Tell 192.168.12.2
2938 121.883821838 Sophos_4d:c5:f1 Broadcast ARP 60 Who has 192.168.12.102? Tell 192.168.12.2
2939 121.974000044 Giga-Byt_66:45:20 Broadcast ARP 60 Who has 169.254.169.254? Tell 192.168.12.225
2942 122.059004038 Giga-Byt_66:45:20 Broadcast ARP 60 Who has 169.254.169.254? Tell 192.168.12.225
2943 122.912992989 Sophos_4d:c5:f1 Broadcast ARP 60 Who has 192.168.12.102? Tell 192.168.12.2
2946 123.083353541 Giga-Byt_67:5c:7b Giga-Byt_66:35:be ARP 60 Who has 192.168.12.114? Tell 192.168.12.146
2947 123.083375628 Giga-Byt_66:35:be Giga-Byt_67:5c:7b ARP 42 192.168.12.114 is at e0:d5:5e:66:35:be
2948 123.059573542 Giga-Byt_66:45:20 Broadcast ARP 60 Who has 169.254.169.254? Tell 192.168.12.225
2949 123.937101456 Sophos_4d:c5:f1 Broadcast ARP 60 Who has 192.168.12.102? Tell 192.168.12.2
2956 126.036523688 Giga-Byt_67:5a:05 Broadcast ARP 60 Who has 169.254.169.254? Tell 192.168.12.199
2957 126.922931717 Giga-Byt_67:5a:05 Broadcast ARP 60 Who has 169.254.169.254? Tell 192.168.12.199
2958 127.932615786 Giga-Byt_67:5a:05 Broadcast ARP 60 Who has 169.254.169.254? Tell 192.168.12.199
2959 128.372255119 Giga-Byt_66:19:f0 Broadcast ARP 60 Who has 169.254.169.254? Tell 192.168.12.247
2960 128.901256919 Giga-Byt_66:19:f0 Broadcast ARP 60 Who has 169.254.169.254? Tell 192.168.12.247
2967 129.889356513 Sophos_4d:c5:f1 Broadcast ARP 60 Who has 192.168.12.102? Tell 192.168.12.2
2968 129.901163158 Giga-Byt_66:19:f0 Broadcast ARP 60 Who has 169.254.169.254? Tell 192.168.12.247
Frame 1: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface enp2s0, id 0
Ethernet II, Src: Giga-Byt_67:5c:7b (e0:d5:5e:67:5c:7b), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Address Resolution Protocol (request)

4. ICMP


*enp2s0
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
icmp
No. Time Source Destination Protocol Length Info
1384 90.932855590 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
2002 92.433856854 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
2088 94.939683825 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
2305 95.748433589 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
2434 98.343731715 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
2454 99.143677664 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
2884 118.382754495 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
2888 119.182708768 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
2937 121.801136019 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
2941 122.612654289 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
3507 148.403559223 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
3533 150.992527881 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
3559 152.506972757 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
3629 155.011204293 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
3646 155.813202612 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
3735 158.445826085 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)
3740 159.254975569 192.168.12.114 192.168.12.146 ICMP 126 Destination unreachable (Port unreachable)


*enp2s0
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
icmp
No. Time Source Destination Protocol Length Info
Destination unreachable (Port unreachable)
Internet Control Message Protocol
Type: 3 (Destination unreachable)
Code: 3 (Port unreachable)
Checksum: 0x97a3 [correct]
[Checksum Status: Good]
Unused: 00000000
Internet Protocol Version 4, Src: 192.168.12.146, Dst: 192.168.12.114

5. Tcp.port == 80


*enp2s0
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
tcp.port==80
No. Time Source Destination Protocol Length Info
Frame 44: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface enp2s0, id 0
Ethernet II, Src: Giga-Byt_68:35:be (e0:d5:5e:68:35:be), Dst: Sophos_4d:c5:f1 (7c:5a:1c:4d:c5:f1)
Internet Protocol Version 4, Src: 192.168.12.114, Dst: 34.107.221.82
Transmission Control Protocol, Src Port: 60518, Dst Port: 80, Seq: 1, Ack: 1, Len: 0