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**Roll Number: 17 (B)**

**Lab Assignment Number: 1**

**Title of Lab Assignment:**

To Study about the Installation Process of NS-3, NetAnim and WireShark in Linux.

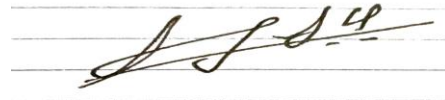
**DOP: 23/03/2023**

**DOS: 13/04/2023**

**CO:**  
**CO1**

**PO:**  
**PO2, PO5,**  
**PSO1**

**Signature:**





## NWL - Practical-1

**Aim:** To Study about the Installation Process of NS-3, NetAnim and WireShark in Linux.

### Theory:

#### Linux:

Linux is a free and open-source operating system based on the Unix operating system. It was developed in the early 1990s by Linus Torvalds, a computer science student at the University of Helsinki, Finland. Linux is known for its stability, security, and flexibility. It is widely used in servers, supercomputers, embedded systems, and mobile devices. Linux also powers many popular open-source software applications, including the Apache web server, the MySQL database, and the Python programming language. There are many different distributions of Linux, including Debian, Ubuntu, Fedora, CentOS, and Red Hat. Each distribution has its own set of features and software packages, but they all share the same core components, including the Linux kernel, which is the heart of the operating system.

Linux is often used by developers and system administrators because of its command-line interface and powerful tools for scripting and automation. However, many Linux distributions also have graphical user interfaces and are user-friendly for non-technical users.

Overall, Linux is a powerful and versatile operating system that is well-suited for a wide range of applications, from web servers and supercomputers to desktops and mobile devices.

#### NS-3 in Linux:

NS-3 is a popular open-source network simulation software tool that is widely used by researchers, engineers, and educators to simulate and analyze various network protocols and technologies. It is designed to simulate both wired and wireless networks and can be used to model a variety of network scenarios.

NS-3 is a discrete-event network simulator that allows you to model and simulate various network protocols and technologies in a controlled environment. It is written in C++ and provides a Python API for scripting and automation.

NS-3 includes a wide range of pre-built network models and protocols, such as TCP, IP, Ethernet, WiFi, LTE, and more. It also allows you to create your own custom network models and protocols using the C++ programming language.

NS-3 is designed to be highly customizable and configurable, allowing you to adjust various parameters and settings to simulate a wide range of network scenarios. It also includes various built-in tools for analyzing and visualizing simulation data, such as trace file output and real-time visualization using tools like Wireshark and NetAnim.

NS-3 is a cross-platform tool and can be used on various operating systems, including Linux, macOS, and Windows. However, it is primarily developed and tested on Linux systems, and using it in Linux may offer some performance advantages due to the lower overhead and greater control over system resources.

NS-3 is licensed under the GNU General Public License (GPL), which means that it is free and open-source software. This allows anyone to use, modify, and distribute NS-3 as long as they comply with the terms of the license.

Overall, NS-3 is a powerful and flexible tool for simulating and analyzing network protocols and technologies in Linux. It requires some programming and networking knowledge to use effectively, but it is well-documented and has a large and active user community that can provide support and guidance.

### WHY NS-3 ?

NS-3 is a popular choice for network simulation for several reasons:

1. **Open-source:** NS-3 is free and open-source software, which means that anyone can use, modify, and distribute it without restrictions. This makes it accessible to a wide range of users, including researchers, engineers, educators, and hobbyists.
2. **Realistic simulations:** NS-3 is designed to provide realistic network simulations, which means that it takes into account real-world network conditions such as network congestion, packet loss, and delay. This makes it useful for simulating and testing network protocols and technologies in a controlled environment before deploying them in real-world scenarios.
3. **Wide range of network models and protocols:** NS-3 includes a wide range of pre-built network

models and protocols, including TCP, IP, Ethernet, WiFi, LTE, and more. It also allows you to create your own custom network models and protocols using the C++ programming language. This makes it a versatile tool for simulating and testing various network scenarios.

4. Customizability: NS-3 is highly customizable and configurable, allowing you to adjust various parameters and settings to simulate a wide range of network scenarios. This makes it useful for testing and optimizing network performance under different conditions.
5. Active user community: NS-3 has a large and active user community that provides support, guidance, and contributions to the project. This makes it easier to get started with NS-3 and to get help if you encounter any issues or have questions.

**PyViz:**

PyViz is a suite of open-source Python visualization tools for creating interactive visualizations and dashboards. It is designed to be easy to use, flexible, and customizable, and it provides a range of options for creating and deploying interactive visualizations for data analysis and exploration.

Some of the key features of PyViz include:

1. Holoviews: Holoviews is a Python library for creating interactive visualizations that can be easily shared and deployed. It provides a simple and intuitive interface for creating visualizations and supports a wide range of data types and sources.
2. Bokeh: Bokeh is a Python library for creating interactive web-based visualizations. It provides a range of tools for creating charts, graphs, and other visualizations that can be easily customized and embedded in web applications.
3. Datashader: Datashader is a Python library for visualizing large datasets. It uses intelligent data sampling and aggregation to create visualizations that are fast, responsive, and easy to interpret.
4. Panel: Panel is a Python library for creating interactive dashboards. It provides a range of tools for building custom dashboards that can be easily shared and deployed.
5. GeoViews: GeoViews is a Python library for creating interactive geospatial visualizations. It provides a range of tools for creating maps, overlays, and other visualizations that are responsive and easy to customize.

**NetAmin:**

A simple animator is presented here, called NetAnim. Written by George Riley, and based on the multi-platform QT4 GUI toolkit, it is capable of animating simulations with PointToPoint links in NS-3. It depicts frames on the links as they travel from node to node.

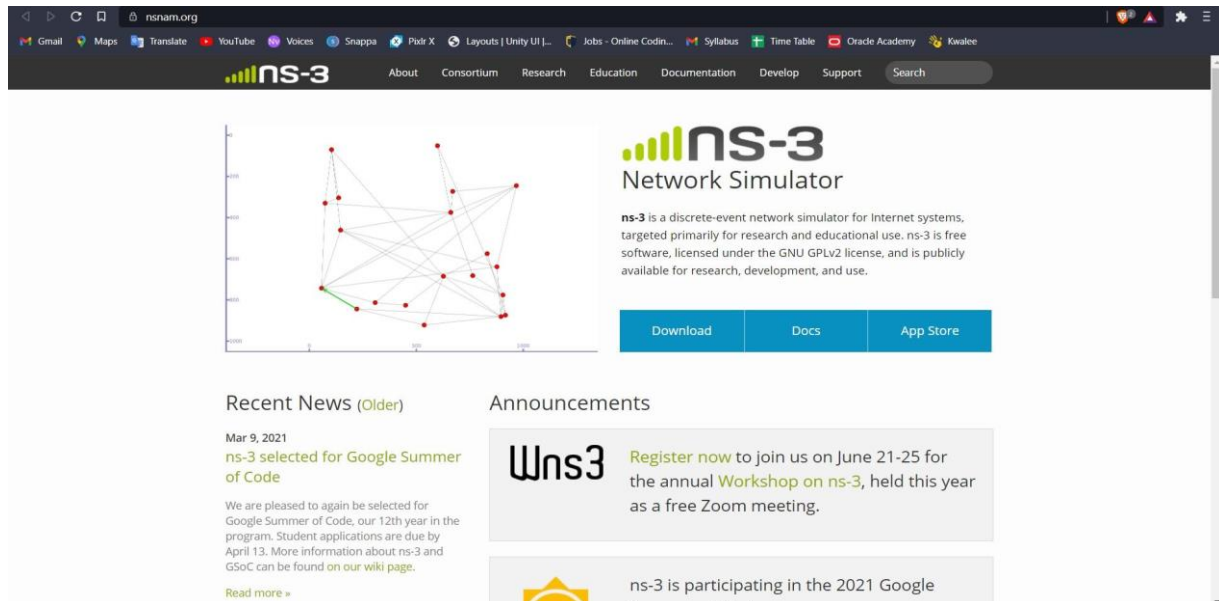
NetAnim requires a custom trace file for animation. This trace file is generated by an animation interface and is included in the current version of NS-3.

NetAnim GUI Features of NetAnim:

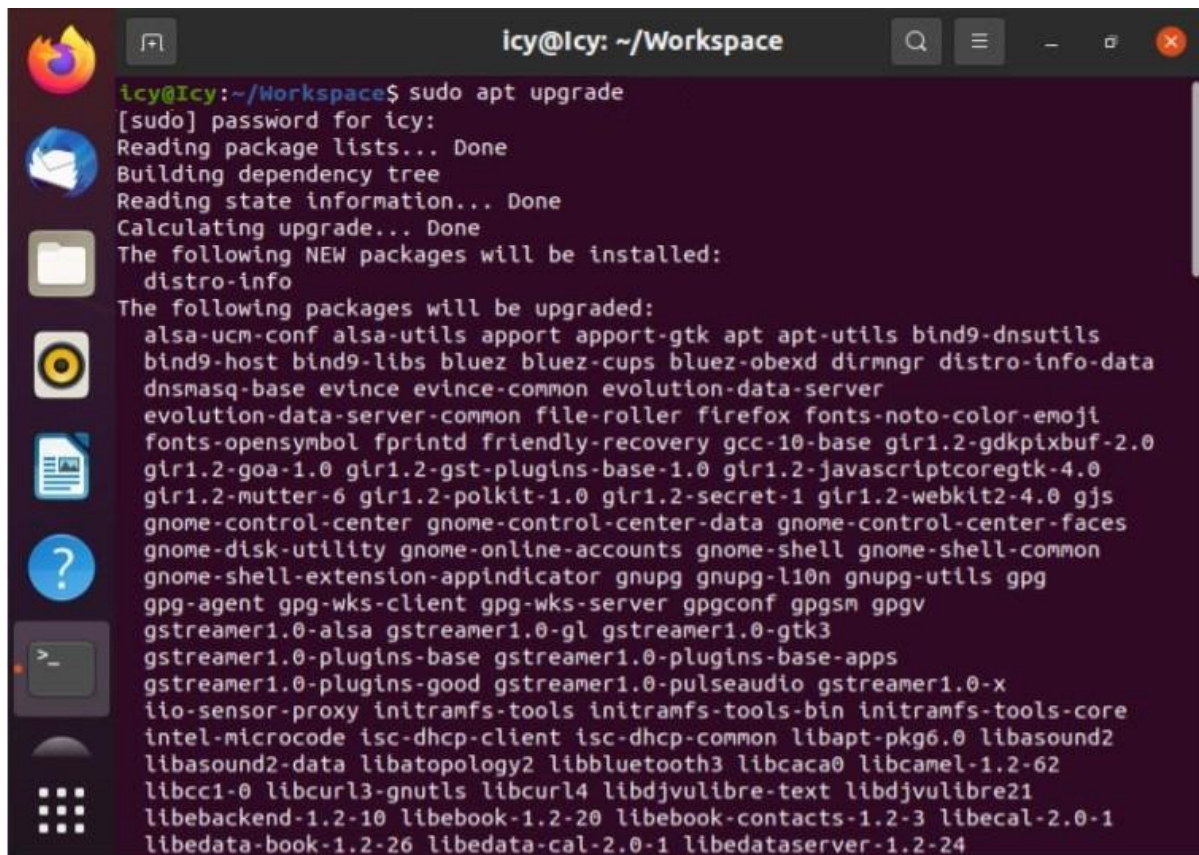
1. Animate packets over wired-links and wireless-links (Limited support for LTE traces. No support for Ipv6)
2. Packet timeline with regex filter on packet metadata.
3. Node position statistics with node trajectory plotting(path of a mobile node).
4. Print brief packet-meta data on packets
5. Parse flow-monitor XML files and display statistics for each flow.
6. Show IP and MAC information, including peer IP & MAC for point-to-point links.
7. Display double or uint32 valued counters vs time for multiple nodes in a chart or a table.
8. Print the routing table at nodes at various points in time

**Installation:**

1. Download ns-allinone-3.32 zip file from <https://www.nsnam.org/> and extract it.

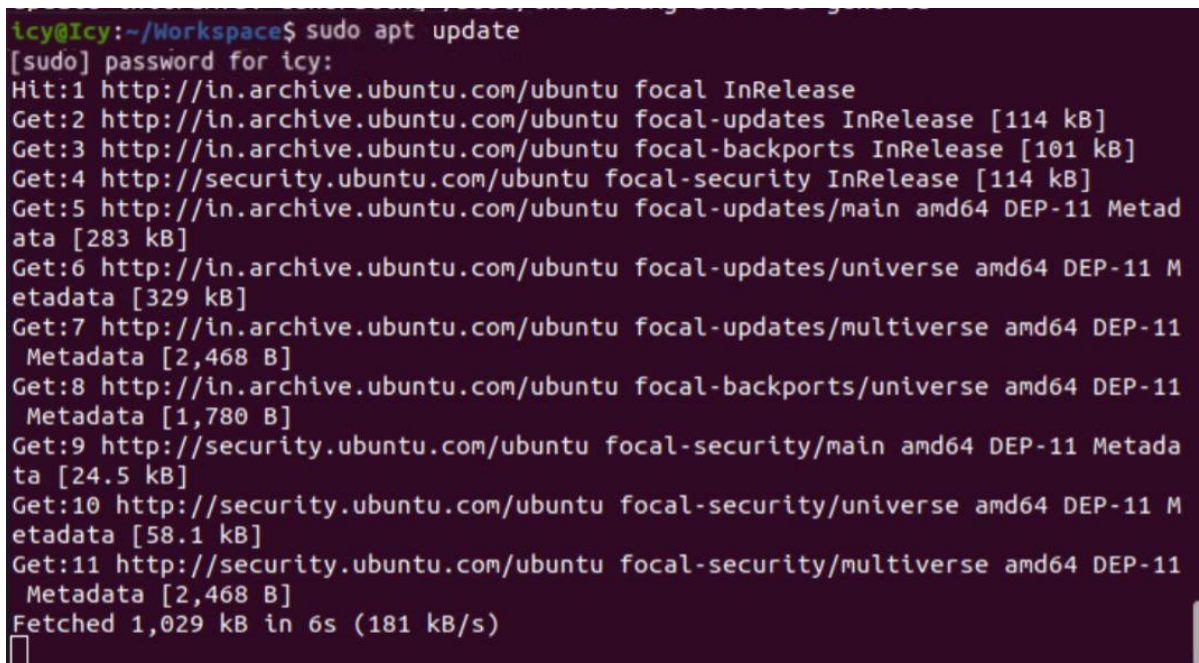


## 2. sudo apt upgrade



```
icy@Icy: ~/Workspace
icy@Icy:~/Workspace$ sudo apt upgrade
[sudo] password for icy:
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
The following NEW packages will be installed:
  distro-info
The following packages will be upgraded:
  alsa-ucm-conf alsa-utils apport apport-gtk apt apt-utils bind9-dnswtills
  bind9-host bind9-libs bluez bluez-cups bluez-obexd dirmngr distro-info-data
  dnsmasq-base evince evince-common evolution-data-server
  evolution-data-server-common file-roller firefox fonts-noto-color-emoji
  fonts-opensymbol fprintd friendly-recovery gcc-10-base gir1.2-gdkpixbuf-2.0
  gir1.2-goa-1.0 gir1.2-gst-plugins-base-1.0 gir1.2-javascriptcoregtk-4.0
  gir1.2-mutter-6 gir1.2-polkit-1.0 gir1.2-secret-1 gir1.2-webkit2-4.0 gjs
  gnome-control-center gnome-control-center-data gnome-control-center-faces
  gnome-disk-utility gnome-online-accounts gnome-shell gnome-shell-common
  gnome-shell-extension-appindicator gnupg gnupg-l10n gnupg-utils gpg
  gpg-agent gpg-wks-client gpg-wks-server gpgconf gpgsm gpgv
  gstreamer1.0-alsa gstreamer1.0-gl gstreamer1.0-gtk3
  gstreamer1.0-plugins-base gstreamer1.0-plugins-base-apps
  gstreamer1.0-plugins-good gstreamer1.0-pulseaudio gstreamer1.0-x
  ilo-sensor-proxy initramfs-tools initramfs-tools-bin initramfs-tools-core
  intel-microcode isc-dhcp-client isc-dhcp-common libapt-pkg6.0 libasound2
  libasound2-data libatopology2 libbluetooth3 libcaca0 libcamel-1.2-62
  libcc1-0 libcurl3-gnutls libcurl4 libdjvulibre-text libdjvulibre21
  libebook-1.2-10 libebook-1.2-20 libebook-contacts-1.2-3 libecal-2.0-1
  libedata-book-1.2-26 libedata-cal-2.0-1 libedataserver-1.2-24
```

## 3. sudo apt update

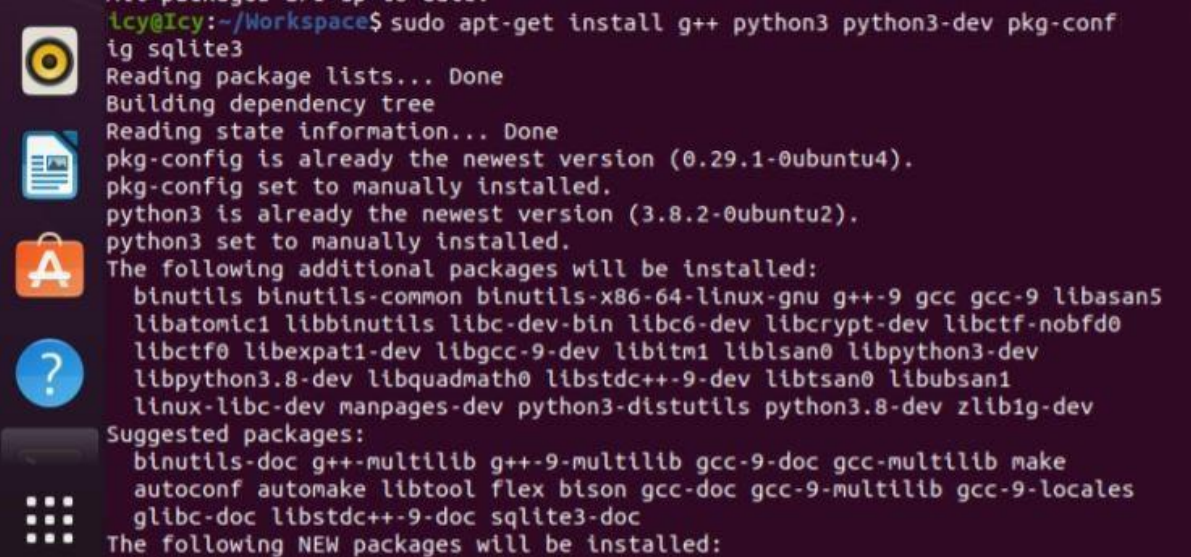


```
icy@Icy:~/Workspace$ sudo apt update
[sudo] password for icy:
Hit:1 http://in.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://in.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://in.archive.ubuntu.com/ubuntu focal-backports InRelease [101 kB]
Get:4 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Get:5 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 DEP-11 Metadata [283 kB]
Get:6 http://in.archive.ubuntu.com/ubuntu focal-updates/universe amd64 DEP-11 Metadata [329 kB]
Get:7 http://in.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 DEP-11 Metadata [2,468 B]
Get:8 http://in.archive.ubuntu.com/ubuntu focal-backports/universe amd64 DEP-11 Metadata [1,780 B]
Get:9 http://security.ubuntu.com/ubuntu focal-security/main amd64 DEP-11 Metadata [24.5 kB]
Get:10 http://security.ubuntu.com/ubuntu focal-security/universe amd64 DEP-11 Metadata [58.1 kB]
Get:11 http://security.ubuntu.com/ubuntu focal-security/multiverse amd64 DEP-11 Metadata [2,468 B]
Fetched 1,029 kB in 6s (181 kB/s)
```



Minimal requirements for Python API users

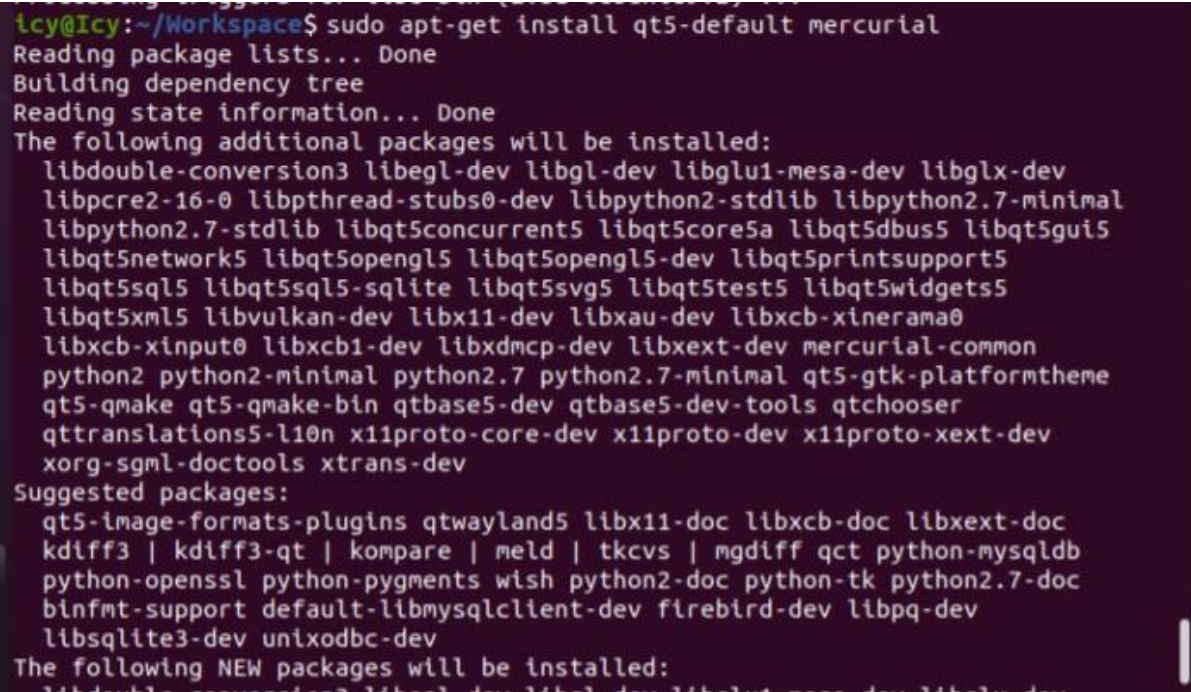
4. `sudo apt-get install g++ python3 python3-dev pkg-config sqlite3`



```
lcy@lcy:~/Workspace$ sudo apt-get install g++ python3 python3-dev pkg-config sqlite3
Reading package lists... Done
Building dependency tree
Reading state information... Done
pkg-config is already the newest version (0.29.1-0ubuntu4).
pkg-config set to manually installed.
python3 is already the newest version (3.8.2-0ubuntu2).
python3 set to manually installed.
The following additional packages will be installed:
  binutils binutils-common binutils-x86-64-linux-gnu g++-9 gcc gcc-9 libasan5
  libatomic1 libbinutils libc-dev-bin libc6-dev libcrypt-dev libctf-nobfd0
  libctf0 libexpat1-dev libgcc-9-dev libitm1 liblsan0 libpython3-dev
  libpython3.8-dev libquadmath0 libstdc++-9-dev libtsan0 libubsan1
  linux-libc-dev manpages-dev python3-distutils python3.8-dev zlib1g-dev
Suggested packages:
  binutils-doc g++-multilib g++-9-multilib gcc-9-doc gcc-multilib make
  autoconf automake libtool flex bison gcc-doc gcc-9-multilib gcc-9-locales
  glibc-doc libstdc++-9-doc sqlite3-doc
The following NEW packages will be installed:
```

5. Netanim animator: qt5 development tools are needed for Netanim animator;

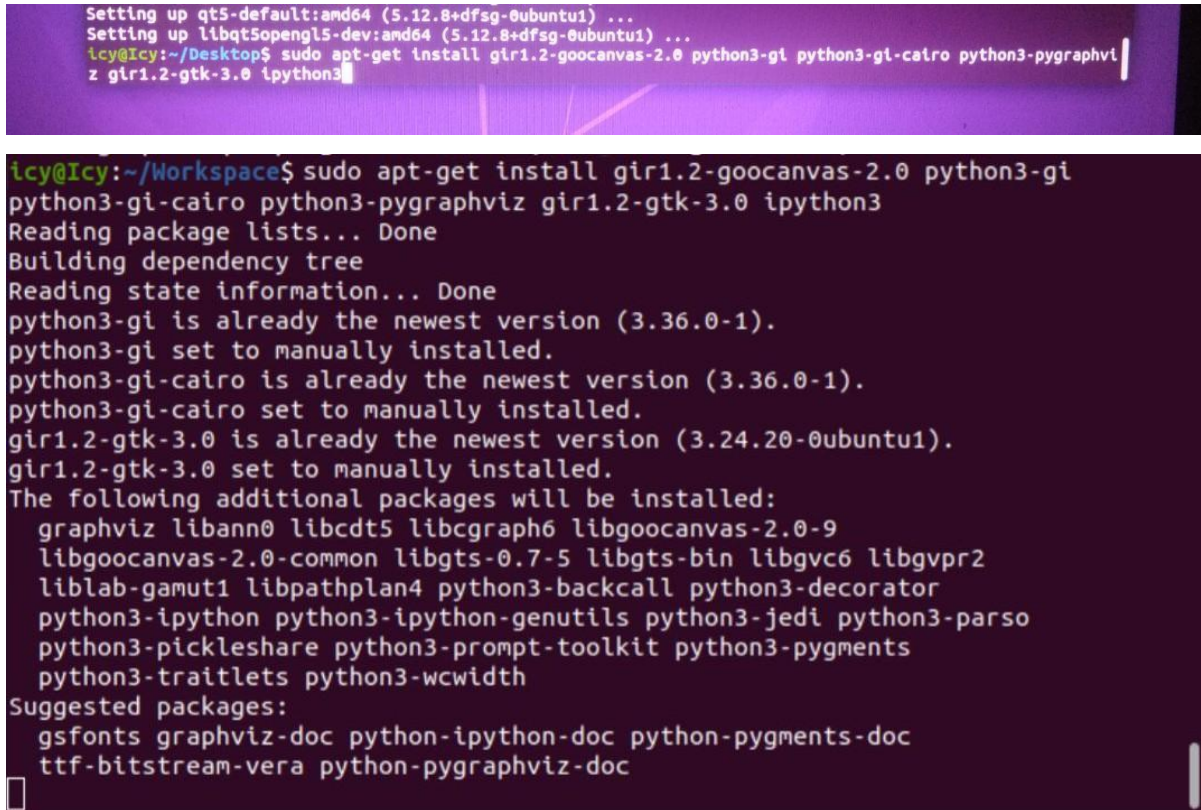
`sudo apt-get install qt5-default mercurial`



```
lcy@lcy:~/Workspace$ sudo apt-get install qt5-default mercurial
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  libdouble-conversion3 libegl-dev libegl-dev libglu1-mesa-dev libglx-dev
  libpcre2-16-0 libpthread-stubs0-dev libpython2-stdlib libpython2.7-minimal
  libpython2.7-stdlib libqt5concurrent5 libqt5core5a libqt5dbus5 libqt5gui5
  libqt5network5 libqt5opengl5 libqt5opengl5-dev libqt5printsupport5
  libqt5sql5 libqt5sql5-sqlite libqt5svg5 libqt5test5 libqt5widgets5
  libqt5xml5 libvulkan-dev libx11-dev libxau-dev libxcb-xinerama0
  libxcb-xinput0 libxcb1-dev libxdmcp-dev libxext-dev mercurial-common
  python2 python2-minimal python2.7 python2.7-minimal qt5-gtk-platformtheme
  qt5-qmake qt5-qmake-bin qtbase5-dev qtbase5-dev-tools qtchooser
  qttranslations5-l10n x11proto-core-dev x11proto-dev x11proto-xext-dev
  xorg-sgml-doctools xtrans-dev
Suggested packages:
  qt5-image-formats-plugins qtwayland5 libx11-doc libxcb-doc libxext-doc
  kdiff3 | kdiff3-qt | kompare | meld | tkcvs | mgdiff qct python-mysqldb
  python-openssl python-pygments wish python2-doc python-tk python2.7-doc
  binfmt-support default-libmysqlclient-dev firebird-dev libpq-dev
  libsqlite3-dev unixodbc-dev
The following NEW packages will be installed:
```

## 6. ns-3-pyviz visualizer

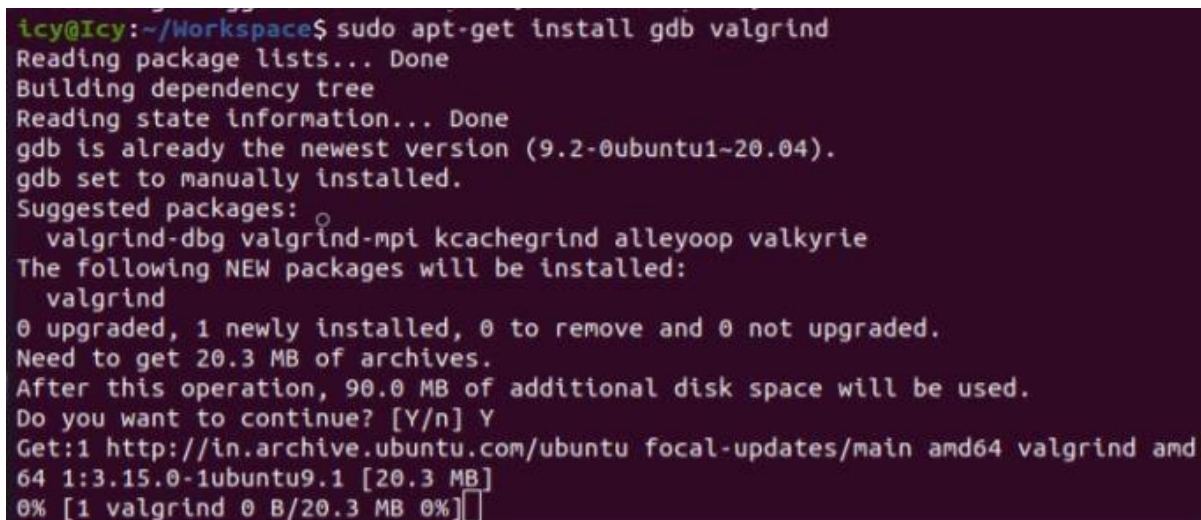
sudo apt-get install gir1.2-goocanvas-2.0 python3-gi python3-gi-cairo python3-pygraphviz gir1.2-gtk-3.0 ipython3



```
Setting up qt5-default:amd64 (5.12.8+dfsg-0ubuntu1) ...
Setting up libqt5opengl5-dev:amd64 (5.12.8+dfsg-0ubuntu1) ...
icy@Icy:~/Desktop$ sudo apt-get install gir1.2-goocanvas-2.0 python3-gi python3-gi-cairo python3-pygraphviz gir1.2-gtk-3.0 ipython3
Reading package lists... Done
Building dependency tree
Reading state information... Done
python3-gi is already the newest version (3.36.0-1).
python3-gi set to manually installed.
python3-gi-cairo is already the newest version (3.36.0-1).
python3-gi-cairo set to manually installed.
gir1.2-gtk-3.0 is already the newest version (3.24.20-0ubuntu1).
gir1.2-gtk-3.0 set to manually installed.
The following additional packages will be installed:
  graphviz libann0 libcdt5 libcgraph6 libgoocanvas-2.0-9
  libgoocanvas-2.0-common libgts-0.7-5 libgts-bin libgvc6 libgvpr2
  liblab-gamut1 libpathplan4 python3-backcall python3-decorator
  python3-ipython python3-ipython-genutils python3-jedi python3-parso
  python3-pickleshare python3-prompt-toolkit python3-pygments
  python3-traitlets python3-wcwidth
Suggested packages:
  gsfonts graphviz-doc python-ipython-doc python-pygments-doc
  ttf-bitstream-vera python-pygraphviz-doc
```

## 7. Debugging

## 8. sudo apt-get install gdb valgrind



```
icy@Icy:~/Workspace$ sudo apt-get install gdb valgrind
Reading package lists... Done
Building dependency tree
Reading state information... Done
gdb is already the newest version (9.2-0ubuntu1~20.04).
gdb set to manually installed.
Suggested packages:
  valgrind-dbg valgrind-mpi kcachegrind alleyoop valkyrie
The following NEW packages will be installed:
  valgrind
0 upgraded, 1 newly installed, 0 to remove and 0 not upgraded.
Need to get 20.3 MB of archives.
After this operation, 90.0 MB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 valgrind amd64 1:3.15.0-1ubuntu9.1 [20.3 MB]
0% [1 valgrind 0 B/20.3 MB 0%]
```



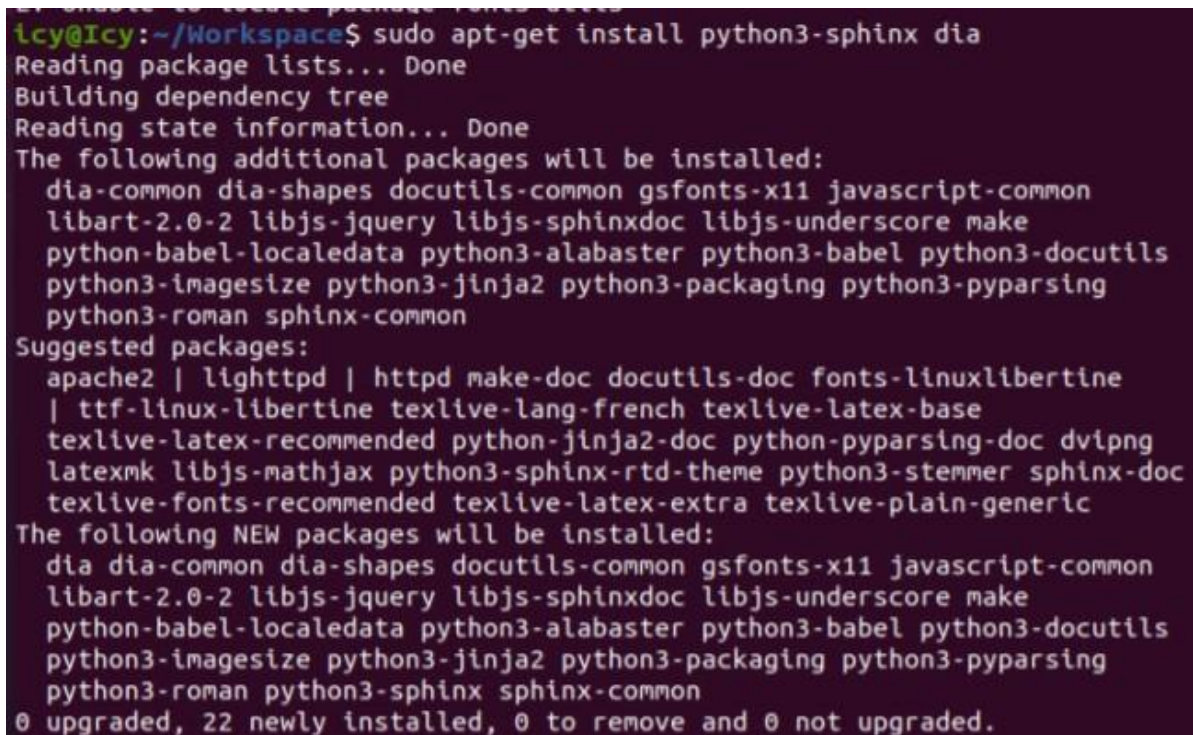
9. Doxygen and related inline documentation:

```
sudo apt-get install doxygen graphviz imagemagick
```

```
sudo apt-get install texlive texlive-extra-utils texlive-latex-extra texlive-font-utils  
dvipng latexmk
```

10. The ns-3 manual and tutorial are written in reStructuredText for Sphinx (doc/tutorial, doc/manual, doc/models), and figures typically in dia (also needs the texlive packages above):

```
sudo apt-get install python3-sphinx dia
```



```
lcy@lcy:~/Workspace$ sudo apt-get install python3-sphinx dia  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following additional packages will be installed:  
  dia-common dia-shapes docutils-common gsfonts-x11 javascript-common  
  libart-2.0-2 libjs-jquery libjs-sphinxdoc libjs-underscore make  
  python-babel-localedata python3-alabaster python3-babel python3-docutils  
  python3-imagesize python3-jinja2 python3-packaging python3-pyparsing  
  python3-roman sphinx-common  
Suggested packages:  
  apache2 | lighttpd | httpd make-doc docutils-doc fonts-linuxlibertine  
  | ttf-linux-libertine texlive-lang-french texlive-latex-base  
  texlive-latex-recommended python-jinja2-doc python-pyparsing-doc dvipng  
  latexmk libjs-mathjax python3-sphinx-rtd-theme python3-stemmer sphinx-doc  
  texlive-fonts-recommended texlive-latex-extra texlive-plain-generic  
The following NEW packages will be installed:  
  dia dia-common dia-shapes docutils-common gsfonts-x11 javascript-common  
  libart-2.0-2 libjs-jquery libjs-sphinxdoc libjs-underscore make  
  python-babel-localedata python3-alabaster python3-babel python3-docutils  
  python3-imagesize python3-jinja2 python3-packaging python3-pyparsing  
  python3-roman python3-sphinx sphinx-common  
0 upgraded, 22 newly installed, 0 to remove and 0 not upgraded.
```

11. To read pcap packet traces Sudo apt-get install tcpdump

## 12. Support for generating modified python bindings

Sudo apt-get install cmake libc6-dev libc6-dev-i386 libclang-6.0-dev llvm-6.0-dev

automake python3-pip

python3 -m pip install --user cxxfilt

```

mint@mint-PC: ~
File Edit View Search Terminal Help
Successfully installed cxxfilt-0.2.2
WARNING: You are using pip version 20.3.2; however, version 21.1.1 is available.
You should consider upgrading via the '/usr/bin/python3 -m pip install --upgrade pip' command.
mint@mint-PC:~$ sudo apt-get install cmake libc6-dev libc6-dev-i386 libclang-6.0-dev llvm-6.0-dev automake python3-pip
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  binfmt-support cmake-data lib32stdc++6 libc-dev-bin libc6 libc6:i386 libc6-dbg libc6-i386 libclang-common-6.0-dev
  libffi-dev libjsoncpp1 libobjc-7-dev libobjc4 librtmp1 libuv1 llvm-6.0 llvm-6.0-runtime
Suggested packages:
  cmake-doc ninja-build glibc-doc glibc-doc:i386 locales:i386 llvm-6.0-doc
Recommended packages:
  gcc-multilib
The following NEW packages will be installed:
  binfmt-support cmake cmake-data lib32stdc++6 libc6-dev-i386 libclang-6.0-dev libclang-common-6.0-dev libffi-dev
  libjsoncpp1 libobjc-7-dev libobjc4 librtmp1 libuv1 llvm-6.0 llvm-6.0-runtime
The following packages will be upgraded:
  libc-dev-bin libc6 libc6:i386 libc6-dbg libc6-dev libc6-i386
6 upgraded, 16 newly installed, 0 to remove and 469 not upgraded.
Need to get 74.7 MB of archives.
After this operation, 568 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libc6-i386 amd64 2.27-3ubuntu1.4 [2,650 kB]
Get:2 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libc-dev-bin amd64 2.27-3ubuntu1.4 [71.8 kB]
Get:3 http://archive.ubuntu.com/ubuntu bionic-updates/main amd64 libc6-dev amd64 2.27-3ubuntu1.4 [2,585 kB]
7% [3 libc6-dev 2,117 kB/2,585 kB 82%]
221 kB/s 5min 16s

```

After installing the required packages, create a folder named Workspace in the home directory and then put the NS3 tar package into the workspace.

Go to terminal and input these commands consecutively after each command finishes executing:

cd

cd workspace

tar xjf <name of NS3 downloaded file name>

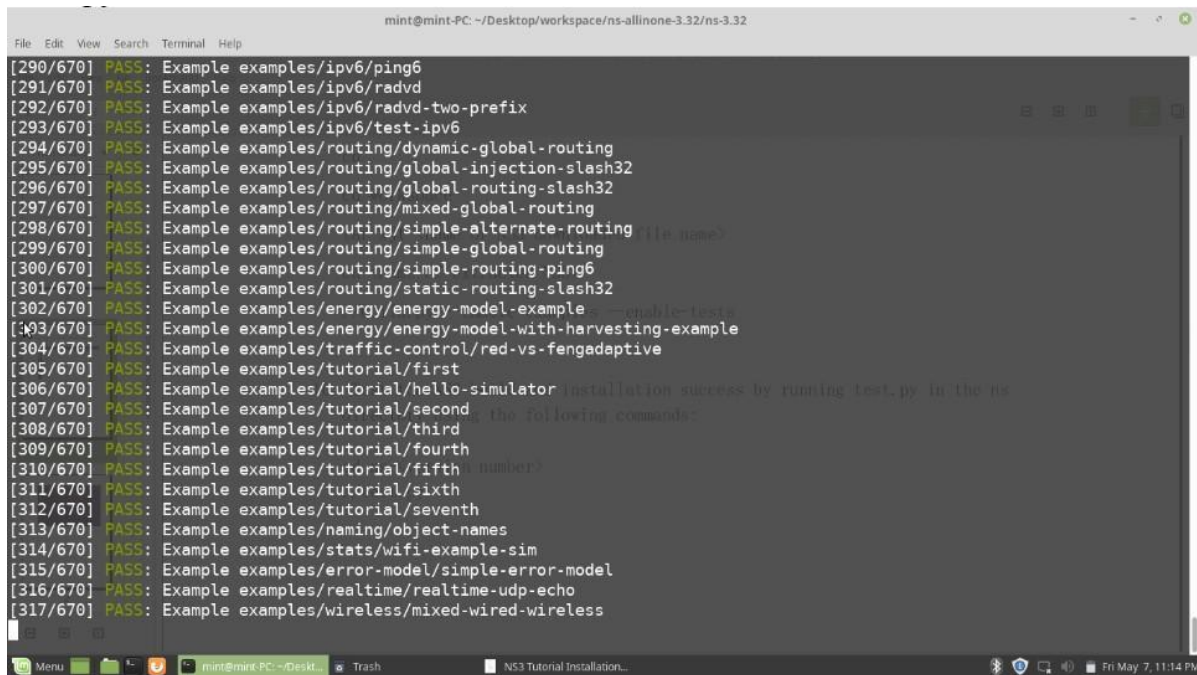
cd <name of extracted NS3>

./build.py --enable-examples --enable-tests It will take some time.

Test the NS3 build and installation success by running test.py in the ns directory using the following commands:

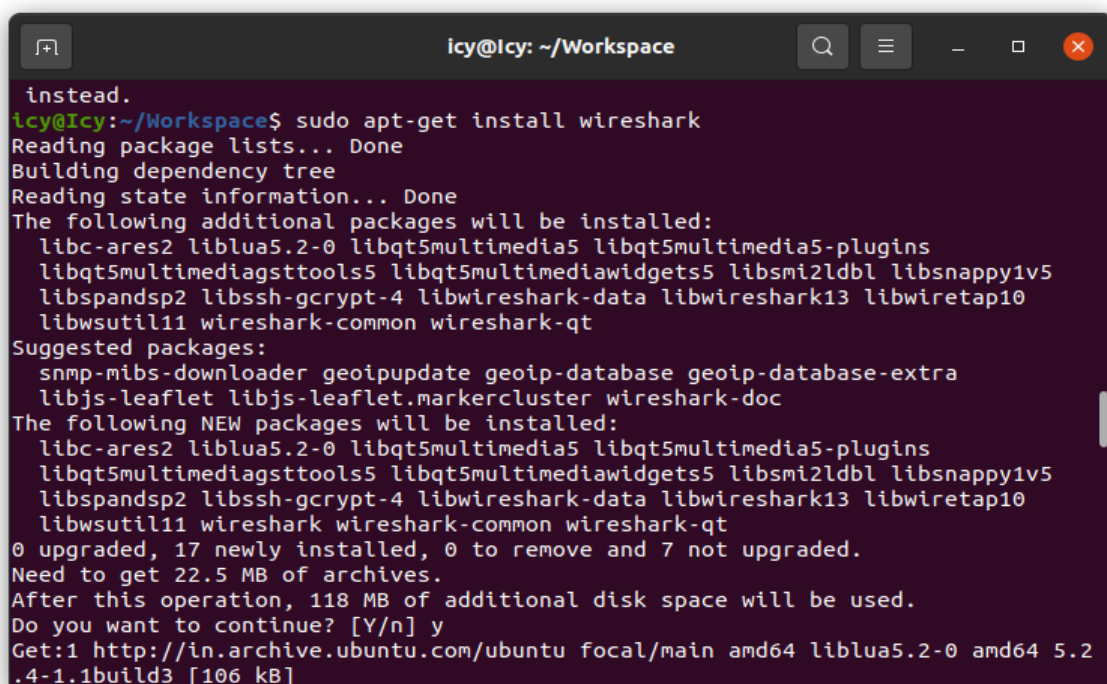
cd ns-<version number>

./test.py



```
mint@mint-PC: ~/Desktop/workspace/ns-allinone-3.32/ns-3.32
[290/670] PASS: Example examples/ipv6/ping6
[291/670] PASS: Example examples/ipv6/radvd
[292/670] PASS: Example examples/ipv6/radvd-two-prefix
[293/670] PASS: Example examples/ipv6/test-ipv6
[294/670] PASS: Example examples/routing/dynamic-global-routing
[295/670] PASS: Example examples/routing/global-injection-slash32
[296/670] PASS: Example examples/routing/global-routing-slash32
[297/670] PASS: Example examples/routing/mixed-global-routing
[298/670] PASS: Example examples/routing/simple-alternate-routing
[299/670] PASS: Example examples/routing/simple-global-routing
[300/670] PASS: Example examples/routing/simple-routing-ping6
[301/670] PASS: Example examples/routing/static-routing-slash32
[302/670] PASS: Example examples/energy/energy-model-example
[303/670] PASS: Example examples/energy/energy-model-with-harvesting-example
[304/670] PASS: Example examples/traffic-control/red-vs-fengadaptive
[305/670] PASS: Example examples/tutorial/first
[306/670] PASS: Example examples/tutorial/hello-simulator
[307/670] PASS: Example examples/tutorial/second
[308/670] PASS: Example examples/tutorial/third
[309/670] PASS: Example examples/tutorial/fourth
[310/670] PASS: Example examples/tutorial/fifth
[311/670] PASS: Example examples/tutorial/sixth
[312/670] PASS: Example examples/tutorial/seventh
[313/670] PASS: Example examples/naming/object-names
[314/670] PASS: Example examples/stats/wifi-example-sim
[315/670] PASS: Example examples/error-model/simple-error-model
[316/670] PASS: Example examples/realtime/realtime-udp-echo
[317/670] PASS: Example examples/wireless/mixed-wired-wireless
```

### Installation of Wireshark:



```
icy@Icy: ~/Workspace
instead.
icy@Icy:~/Workspace$ sudo apt-get install wireshark
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  libc-ares2 liblua5.2-0 libqt5multimedia5 libqt5multimedia5-plugins
  libqt5multimediasgsttools5 libqt5multimediawidgets5 libsmi2ldbl libsnappy1v5
  libspandsp2 libssh-gcrypt-4 libwireshark-data libwireshark13 libwiretap10
  libwsutil11 wireshark-common wireshark-qt
Suggested packages:
  snmp-mibs-downloader geoipupdate geoip-database geoip-database-extra
  libjs-leaflet libjs-leaflet.markercluster wireshark-doc
The following NEW packages will be installed:
  libc-ares2 liblua5.2-0 libqt5multimedia5 libqt5multimedia5-plugins
  libqt5multimediasgsttools5 libqt5multimediawidgets5 libsmi2ldbl libsnappy1v5
  libspandsp2 libssh-gcrypt-4 libwireshark-data libwireshark13 libwiretap10
  libwsutil11 wireshark-common wireshark-qt
0 upgraded, 17 newly installed, 0 to remove and 7 not upgraded.
Need to get 22.5 MB of archives.
After this operation, 118 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://in.archive.ubuntu.com/ubuntu focal/main amd64 liblua5.2-0 amd64 5.2
.4-1.1build3 [106 kB]
```

**Conclusion:** Installation Process of NS-3, NetAnim and WireShark in Linux is studied.