CSCD58 Computer Networks
Networks Simulation Packages

Marcelo Ponce

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Department of Computer and Mathematical Sciences - UTSC

Today's Tutorial

Network Simulation Packages

- Cisco Packet Tracer
- EVE-Emulated Virtual Environment
- GNS3 – Graphical Network System 3
- NS3 - Network Simulator

Other Network Tools

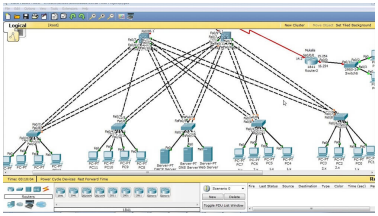
- Wireshark
- PRTG Network Monitor

References

Network Simulation Packages

Cisco Packet Tracer

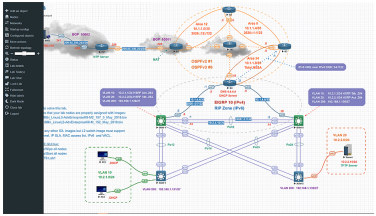
- Cisco Packet Tracer is a network simulation tool built by Cisco Systems.
- It can make a simple or complex network inside the Packet tracer to create, plan, configure, and test your network scenarios in a completely virtual ecosystem.
- This Network Simulation tool allows users to create network topologies and imitate those in modern computer networks.
- Packet Tracer is one of the most well-known Networks Simulation software among networking aspirants and beginners.
- Used in the Cisco CCNA Certification Training.



https://www.netacad.com/courses/packet-tracer

EVE-Emulated Virtual Environment

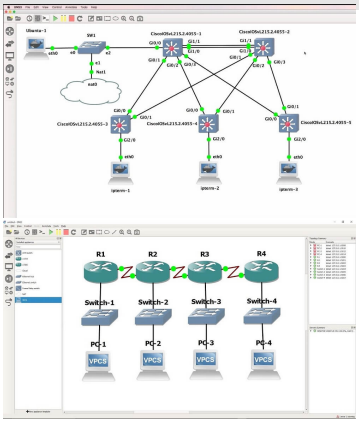
- EVE is a *Network Virtual Environment Tool & Software*
- Used for *Emulated Virtual Environment For Network, Security and DevOps*
- It can emulate almost every kind of Network or Security Appliance and build, plan, configure, and test complex network scenarios in a completely risk-free virtual environment in your machine.



`https://www.eve-ng.net/`

GNS3 – Graphical Network System 3

- Graphical Network System 3 (GNS 3) is Network Simulation/Emulation Tool & Software
- Free software, open source
- GNS3 can simulate complex networks and scenarios and supports the combination of virtual and real network devices.
- GNS3 is one of the best network simulation tools to build, design, configure, and test your network scenarios in a completely risk-free virtual environment.
- GNS3 network simulation tool is available for Windows, Linux & Mac OSs.



https://docs.gns3.com/docs/

https://www.gns3.com/software

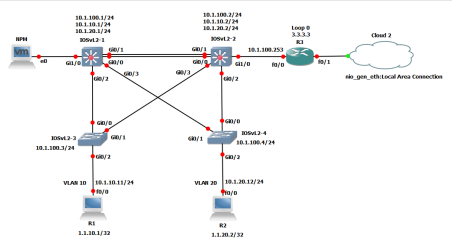
GNS3 – Architecture

GNS3 consists of two software components

- The GNS3-all-in-one software (GUI)
- The GNS3 virtual machine (VM)

GNS3 - Server options

- Local GNS3 server
- Local GNS3 VM
- Remote GNS3 VM

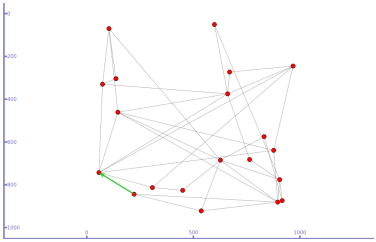


GNS3 supports emulation & simulation

- GNS3-emulation: mimics or emulates the hardware of a device
- GNS3-simulation: simulates features and functionality of a given device

Network Simulator NS3

- NS is a name for a series of discrete event network simulators, specifically ns-1, ns-2, and ns-3.
- The Network Simulator NS3 is a discrete event simulator targeted at networking research.
- Network Simulator NS3 tool provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks.
- It is publicly available for research, development, and use.



https://www.nsnam.org/

ns3 – Generalities

- ns-3 is a discrete-event network simulator for Internet systems
- targeted primarily for research and educational use
- free, open-source, licensed under the GNU GPLv2 license
- ns-3.43 latest version (Oct. 2024)

ns3 – Generalities

- ns-3 is a discrete-event network simulator for Internet systems
- targeted primarily for research and educational use
- free, open-source, licensed under the GNU GPLv2 license
- ns-3.43 latest version (Oct. 2024)
- At the beggining of 2022, ns3 switched fron `waf` $\rightsquigarrow$ `cmake`
  $\Rightarrow$ switch `./waf` $\rightsquigarrow$ `./ns3`
- `https://www.nsnam.org`
- `https://gitlab.com/nsnam/ns-3-dev`

- Recommend using `mathlab.utsc.utoronto.ca`

* ns3 v3.35, using `waf`:

```
# download ns-3
cd
mkdir tarballs
cd tarballs
wget http://www.nsnam.org/releases/ns-allinone-3.35.tar.bz2
tar xjf ns-allinone-3.35.tar.bz2

# Buld ns-3
./build.py
```

ns3 __ Getting started ii

https://www.nsnam.org/docs/release/3.6/tutorial/tutorial_11.html#Getting-Started

* ns3 v3.36.1:

```
# download ns-3
cd
mkdir workspace
cd workspace
wget https://www.nsnam.org/releases/ns-allinone-3.36.1.tar.bz2
tar xjf ns-allinone-3.36.1.tar.bz2

# Buld ns-3
./build.py --enable-examples --enable-tests
```

https://www.nsnam.org/docs/release/3.36/tutorial/html/getting-started.html

ns3 __ Configuration & Build i

- Configuration, using `waf`

```
cd ns-3.35
./waf -d optimized configure

# switch to debug build
./waf -d debug build

# build debug versions of ns-3 projects
./waf
```

WARNING
The build can take **SEVERAL** minutes!!!

- more...

```
./waf --help
```

https://www.nsnam.org/docs/release/3.6/tutorial/tutorial_13.html#Building-ns_002d3

ns3 __ Configuration & Build ii

- Configuration

```
cd ns-3.36
./ns3 clean
./ns3 configure --build-profile=optimized --enable-examples --enable-tests

# switch to debug build
./ns3 clean
./ns3 configure --build-profile=debug --enable-examples --enable-tests

# build debug versions of ns-3 projects
./ns3 build

# for checking the profile
./ns3 --check-profile
```

WARNING
The build can take **SEVERAL** minutes!!!

- more... `./ns3 --help`

ns3 __ Configuration & Build iii

https://www.nsnam.org/docs/release/3.6/tutorial/tutorial_13.html#Building-ns_002d3

ns3 – Conceptual Overview

- **Node**: basic computing device abstraction – C++ class Node
- **Application**: basic abstraction for a user program that generates some activity to be simulated – C++ class Application
- **Channel**: connects a Node to an object representing a communication channel – C++ class Channel
- **Net device**: covers both the software driver and the simulated hardware. A net device is "installed" in a Node in order to enable the Node to communicate with other Nodes in the simulation via Channels – C++ class NetDevices
- **Topology helpers**: arrange many connections between Nodes, NetDevices and Channels – topology helper objects.

https://www.nsnam.org/docs/release/3.6/tutorial/tutorial_17.html#Key-Abstractions

- Modules includes – `../../build/debug/ns3`
- Logging: `NS_LOG_COMPONENT_DEFINE ("FirstScriptExample");`

```
cd ns-3.35
cd examples/tutorial
# look into first.cc
# also available as first.p
```

- Creation of the ns-3 Node objects

```
NodeContainer nodes;
nodes.Create (2);
```

- Construction of a point-to-point link

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

- Creation, config. and installation of devices

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

- Protocol stack – internet stack (TCP, UDP, IP, ...)

```
InternetStackHelper stack;
stack.Install (nodes);
```

* with `waf`:

```
cd ..   # at base level of ns-3.35

# copy script to scratch
cp examples/tutorial/first.cc scratch/myfirst.cc

# compile
./waf

# run the example
./waf --run scratch/myfirst
```

ns3 __ Building scripts ii

```
cd ..   # at base level of ns-3.36

# copy script to scratch
cp examples/tutorial/first.cc scratch/myfirst.cc

# compile
./ns3

# run the example
## ./ns3 run <ns3-program> --command-template="%s <args>"
./ns3 run scratch/myfirst
```

ns3 __ More examples

```
# Located at ns3-3.3x/examples
ls examples
channel-models  error-model  naming    socket  traffic-control  udp-client-
    server
CMakeLists.txt  ipv6     realtime  stats   tutorial     wireless
energy    matrix-topology  routing   tcp     udp
```

ns3 __ A real example

https://www.nsnam.org/docs/release/3.6/tutorial/tuto
`ns-3.35/examples/fifth.cc`

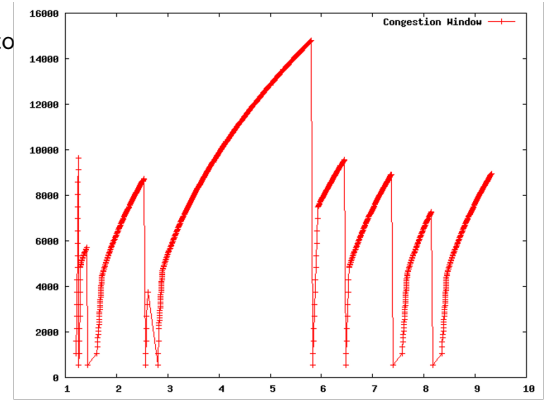
Congestion window in TCP

You could use this example as one of the two cases that your lab.report should include.

Your plot WILL NOT look identical but similar.

You don't need to use gnuplot to produce the plot.

You may need to clean some of the entries in your data file.



NS3 – Main Resources & References

- https://www.nsnam.org
- https://www.nsnam.org/documentation/
- https://www.nsnam.org/docs/release/3.6/tutorial/tutorial_11.html#Getting-Started
- https://www.nsnam.org/docs/release/3.6/tutorial/tutorial_30.html

Other Network Tools

Other Network Tools

- Wireshark
- PRTG Network Monitor

Wireshark

- Wireshark is a free and open-source packet analyzer.
- Wireshark development project, started by Gerald Combs in 1998, is today's world's foremost and widely-used network protocol analyzer.
- It is used for network troubleshooting, interpretation, review, protocol development, and education.
- Wireshark will also help you see what's happening on your network at a microscopic level.

`https://www.wireshark.org/`

PRTG Network Monitor

- PRTG is a network monitoring tool that supports you in ensuring that your computer systems are working easily and that there are no interruptions and outages.
- Network monitoring is also essential to increase the efficiency of your network by knowing bandwidth and resource consumption.

https://www.paessler.com/prtg

References

- Zarrad A, Alsmadi I "Evaluating network test scenarios for network simulators systems." International Journal of Distributed Sensor Networks. 2017;13(10). doi:10.1177/1550147717738216 – https://doi.org/10.1177/1550147717738216
- https://networksimulationtools.com/network-simulation-tools-projects/