

## A CRITICAL REVIEW OF VISUAL SIMULATION TOOLS FOR NETWORK MODELLING

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### ABSTRACT

In this paper we give a brief overview of network simulators that aid in the design, analysis and simulation of network and protocols. The Simulators under review are the Cisco Packet Tracer, Optimized Network Engineering Tool(OPNET) IT guru, GNS3 and Easy-EIGRP. The Cisco Packet Tracer is open source while the Optimized Network Engineering Tool is commercially available. Easy-EIGRP supports only the Enhanced Interior Gateway Routing Protocol making it limited in its capabilities. The GNS3 is an emulator and supports limited number of networking devices. The Cisco Packet offers more options and capabilities than the other Network simulators. It is recommended for designs where Network connectivity is paramount.

**Keywords:** Cisco Packet Tracer, GNS3, Optimized Network Simulator, Easy-EIGRP, Simulators, Command Line Interface (CLI).

### 1. INTRODUCTION

There are varied simulation tools in existence today which enable modelling of network performance and behaviour after designing. They also aid in researching, this is because they give answers to the key questions asked by network administrators. Visualization of these tools is imperative for easy grasp of networking concepts [1]. It is also important this simulation tools are designed to be user friendly, this is enhanced by Graphical User interface. We enumerate network simulators that enable users to emulate network performance and behaviours. For the purpose of this study, the Cisco packet was given a detailed analysis, though the GNS3 Graphical network simulator, OPNET IT Guru and Easy-EIGRP is discussed briefly.

#### Cisco Packet Tracer

Packet tracer is proprietary software from Cisco used for simulation of real time network environment [2,3]. It also for educational purposes as regards to teaching and learning of internetwork technologies and protocols. It is an interactive tool and provides the opportunity for users to design and configure network devices. During simulation, the movements of packets from one network device to another can be monitored and abnormal activity detected which will aid in maintenance. It also offers the opportunity to study the various network devices in details and to understand their operations thereby deepening technical knowledge. It is not complex to use, its friendly interfaces (GUI and CLI) offer a rich interactive suite thereby offering several benefits to any potential network geek. It can be downloaded from the internet at no cost.

Users from different geographical locations can make use of its multi-user features for collaborative efforts on any networking projects. It has two types of Workspace;

- **Logical Workspace:** In this environment logical designs can be implemented. It allows for devices to be inserted.
- **Physical Workspace:** This supports real time network designs together with its geographical implications.

Packet tracer has two types of modes;

- **Real-time Mode:** In this mode the devices operate as they would in real time.
- **Simulation Mode:** This is a virtual model of device behaviour. Network issues can be detected in this mode and troubleshooting carried out.

- Packet tracer is supported by an array of networking devices which can be configured and they include Routers, Hubs, Switches, Wireless devices, Connections, End devices, WAN emulation, Custom Made devices, Multi-User connections, Personal Computer, Laptops, Servers, Printers, IP phones, VOIP Devices, Analog-phones, Wireless tablets, PDAs, Wireless Devices [4].

The cable connections to connect these devices in a network includes Cross over cable, Copper straight-through cable, Copper Cross-over cable, Fibre cable, Phone cable, Coaxial cable, Serial DTE, Serial DCE and Octal Cable [4].

It also supports several services which include HTTP, DHCP, TFTP, DNS, SYSLOG, AAA, NTP, EMAIL, FTP, FIREWALL, IPV6 [4].

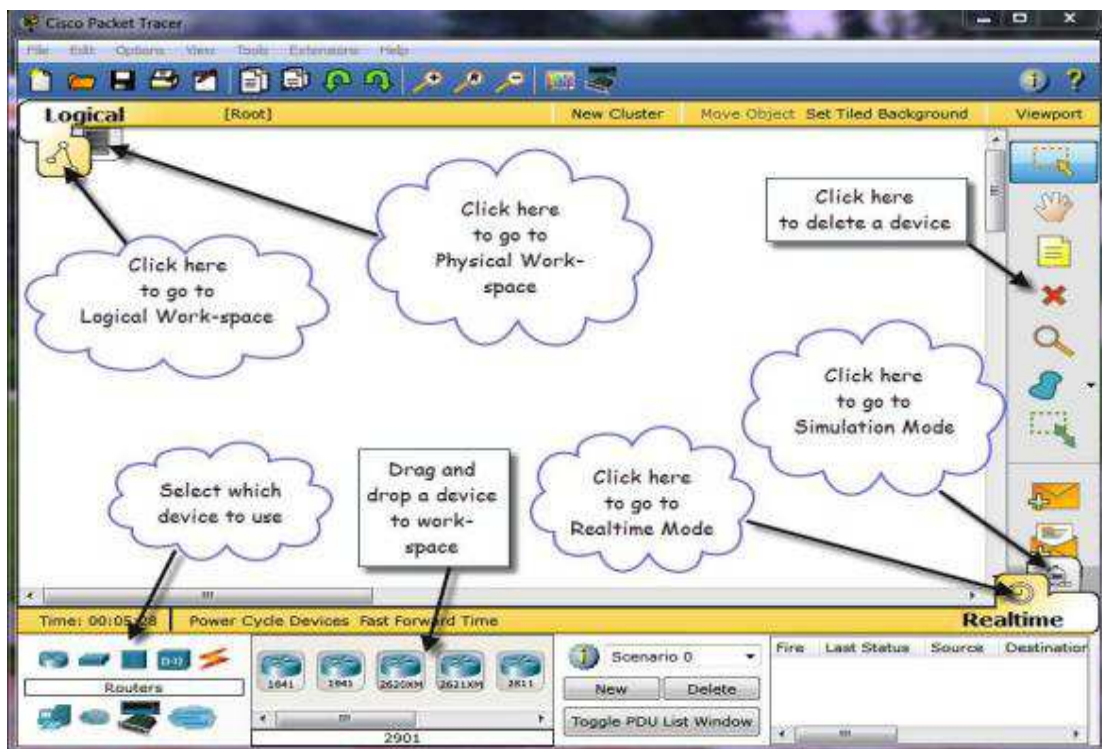
The table below [5] shows the device connections and the appropriate cables to be used in their connections.

**Table 1: Network Devices and Connection media [5]**

| Network Devices  | Connection Cables |
|------------------|-------------------|
| PC to PC         | Cross Over cable  |
| PC to Router     | Cross Over cable  |
| PC to Switch     | Straight Cable    |
| Switch to Router | Straight Cable    |
| Router to Router | Serial Cable      |

Packet tracer use the following tools to enable communication between nodes in a network; Command prompt, Web Browser, Wireless connections, VPN, Traffic Generator, MIB browser, Cisco IP Communicator, Email, PPPoE Dialler, Text Editor [6,7].

In the Command Line interface, configurations commands can be entered into a terminal emulator [8] to configure a particular device.



**Fig 1: Cisco Packet Tracer Workspace[5]**

A router can be configured using the following commands [5,9]

Router>enable

Router#configure terminal

```
Router(config)# interface FastEthernet0/0
Router(config)# ip address 192.168.1.0 255.255.255.0
Router(config)# no shutdown
Router(config)# interface serial0/1/0
Router(config)# ip address 172.115.1.0 255.255.255.0.0
Router(config)# no shutdown
```

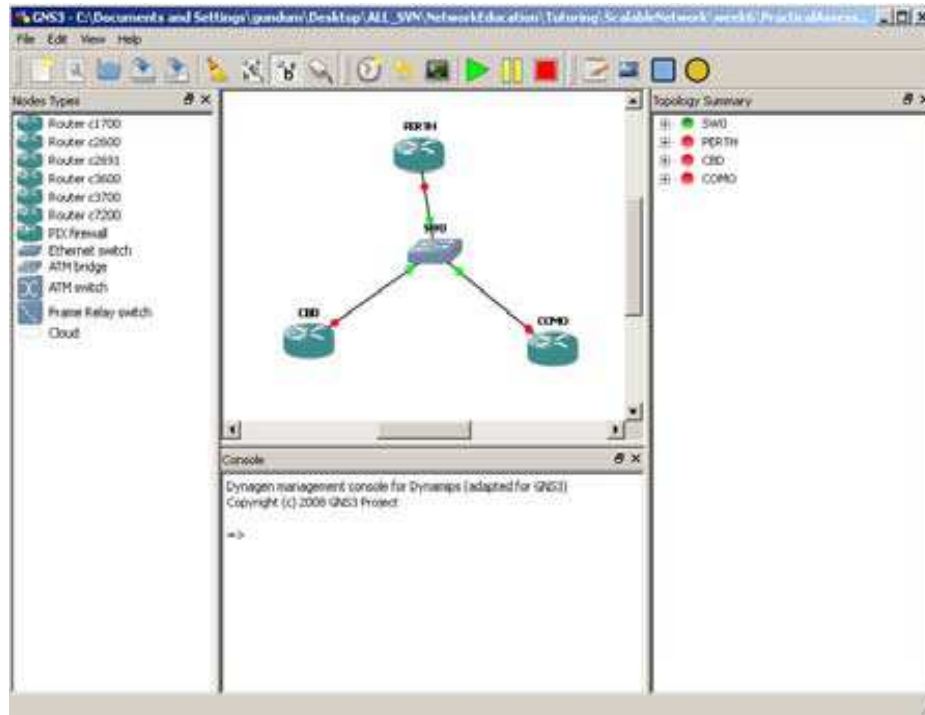
The table below[5] shows the different modes of a router and the symbols representing them

**Table 2: Router Mode and Symbol [5]**

| Mode                         | Symbol              |
|------------------------------|---------------------|
| User Mode                    | Router>             |
| Privilege Mode               | Router#             |
| Global Configuration Mode    | Router(config)#     |
| Interface Configuration Mode | Router(configif)#   |
| Line Configuration Mode      | Router(configline)# |

## 2. GNS3 GRAPHICAL NETWORK SIMULATOR

GNS3 enables users to design and configure network devices using the command line interface. It has a downside which is it doesn't have a network operating system [10]. It also consumes huge amount of computing resources



**Fig 2: GNS3 Design screen [10]**

Just like the Packet tracer, the GNS3 is open source and can be downloaded freely on the internet. It supports a limited number of network devices that is routers and switches, this means its capability is far lower than the Packet tracer. It doesn't have the facility to analyze data traffic or network behaviour. It only visualizes the logical workspace unlike the Packet tracer that visualizes both the logical and physical workspace. Another limitation is that there is no detailed description of devices. Network Interface cards can be emulated by running them on a Cisco Internetwork Operating system [10].

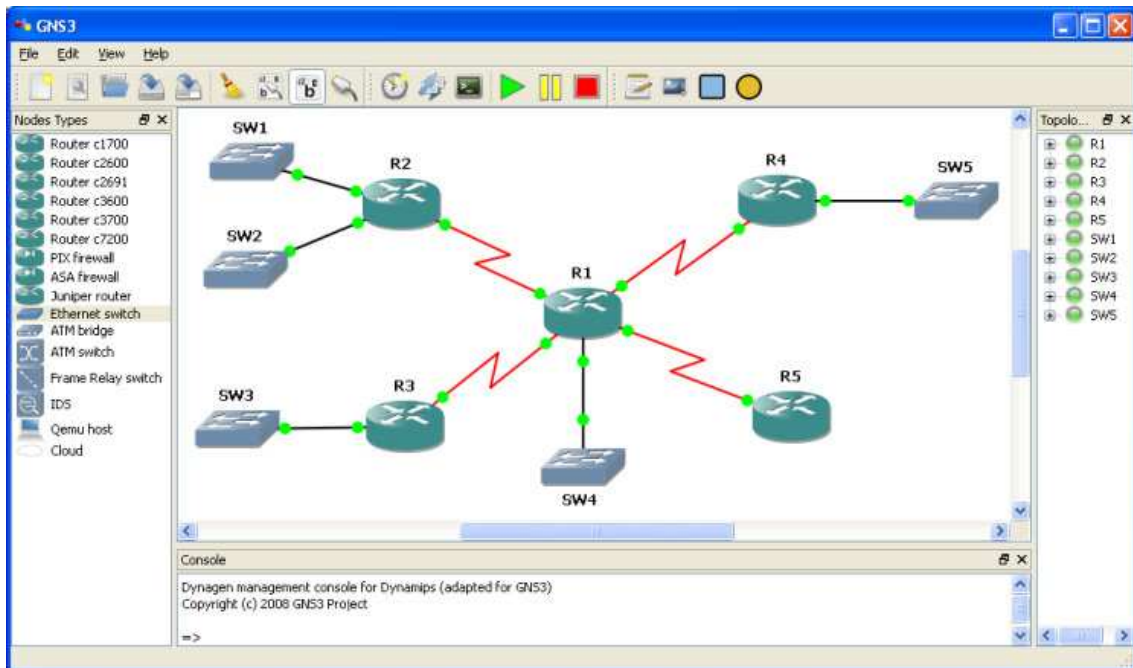


Fig 3: GNS3 Window [11]

**Optimized Network Engineering Tool(OPNET) IT Guru**

This is a commercially available simulation tool that supports all EIGRP commands and a user interactive GUI. Users can build, design, analyze networks using this simulation tool. It does not employ CLI for configuration of network devices but it can be done through interactive dialog boxes. Using ping facility IP addresses can be verified. One of the advantages of this simulation tool over the Packet tracer is that network performance can be analyzed in the event of increased traffic. This tool enables users to compute the path metrics that enables EIGRP to route packets through the path with the least cost. It also filters protocols during simulation [12].

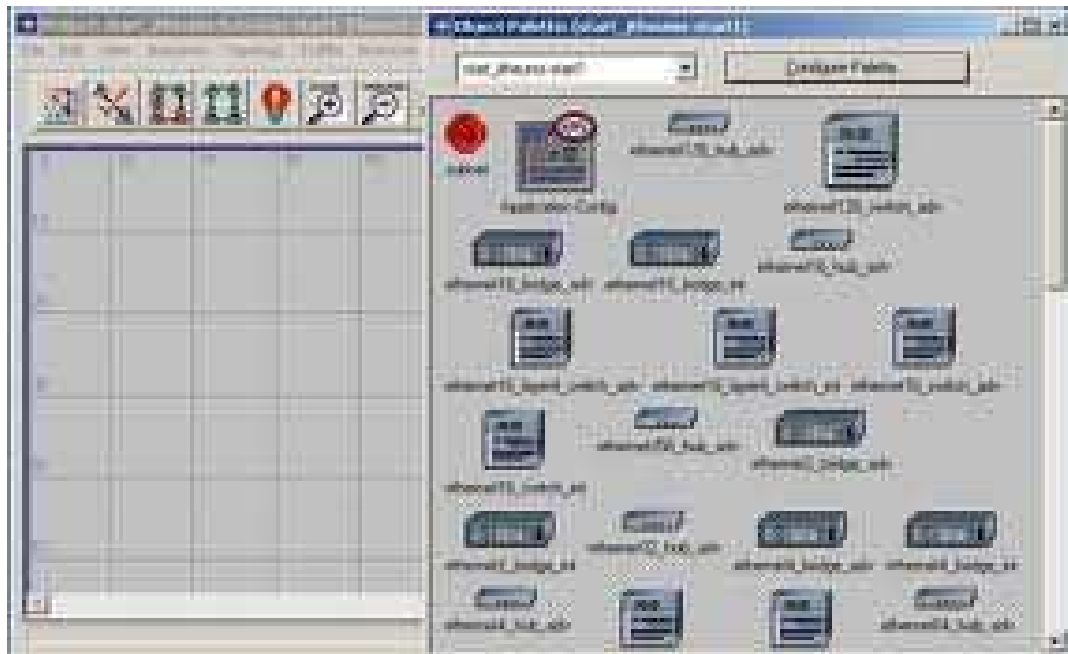


Fig 4: OPNET IT Guru Window [11]

### Easy-EIGRP

This is an EIGRP simulation tool used for teaching EIGRP concepts and application. The Easy-EIGRP is made up of the following modules

**EIGRP settings:** This enables users to set and configure the network. Such network characteristics like IP address, subnet mask, bandwidth and delay can be set from this module [13]. Router properties like the Autonomous system number, Maximum Retransmission allowed can be configured and the path constants can be computed using this module



Fig 5: Easy-EIGRP Settings module [11]

**DUAL Finite State Machine:** This module enables users to view EIGRP finite state machine events [13].

**Partial Network Map:** This gives an illustration based on the router updates sent from neighbouring routers. It uses visual icons to indicate the presence and absence of neighbouring routers

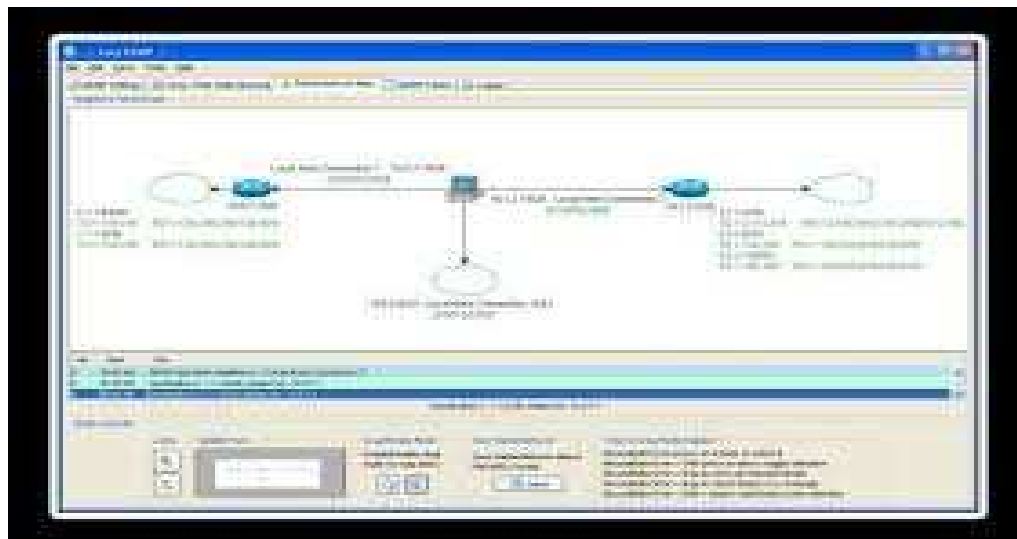


Fig 6: Easy-EIGRP Partial Network Map[11]

**EIGRP Tables:** The tables are IP Routing Table, Neighbour Table, Topology Table and Complete Topology Table. These are different from one another based on their colours and whenever there is network change, the tables are automatically updated [13].

**Logger:** This collects processed information in a tabular form and EIGRP packets checksum can be calculated by clicking on the checksum field.

### 3. CONCLUSION

Network simulators are very important in designing and simulating a network for varied applications. From our review, it would be seen that the Cisco Packet Tracer offers more services and options than other simulators under review. It is recommended for networks where scalability and improved performance is needed.

### REFERENCES

- [1] Al-Holou N, Booth KK, Yaprak E. Using computer network simulation tools as supplements to computer network curriculum. *Frontiers in Educ. Conf.*, 2000. FIE 2000. 30<sup>th</sup> Annual, 2000; 2: S2C/13-S2C/16
- [2] Janitor J, Kniewald K. Visual Learning Tools for Teaching/Learning Computer Networks. In: ICNS'10 Proceedings of the 6<sup>th</sup> International Conference on Networking and Services, Cancun, Mexico, 2010.
- [3] Islam K, Alessandro LD. Cisco Academy Support Center and Distance Education Course. In: Proc. of the Ninth International Conference on Networking and Services (ICNS) 2013.
- [4] Cisco, Packet Tracer, [http://www.cisco.com/web/learning/netacad/course\\_catalog/PacketTracer.html](http://www.cisco.com/web/learning/netacad/course_catalog/PacketTracer.html) accessed 10<sup>th</sup> September 2014.
- [5] Sheikh JR. Role of Packet Tracer in learning Computer Networks. *International Journal of Advanced Research in Computer and Communication Engineering* 2014; 3(5).
- [6] Wang M. Packet Tracer 5.0, Packet Tracer Messaging Protocol (PTMP), Specifications Document: Cisco Systems, 2008.
- [7] Smith A, Bluck C. Multiuser collaborative practical learning using Packet tracer. Sixth international conference on Networking and services IEEE 2010.
- [8] Deal R. Cisco Certified Network Associate Study Guide. McGraw-Hill Osborne. Third Edition. April, 2008.
- [9] Prieto-Blazquez J. et al. An Integrated Structure for a Virtual Networking Laboratory. *IEEE transactions on Industrial Electronics* 2008; 55(6): 2334-2342.
- [10] GNS3, GNS3: graphical network simulator, 10<sup>th</sup> September 2014, <http://www.gns3.net/>
- [11] Exposito J, Trujillo V, Gamess E. Using Visual Educational Tools for the Teaching and Learning of EIGRP. Proc. of the World Congress on Engineering and Computer Science , Vol. 1, WCECS 2010, October 20-22, 2010, San Francisco, USA, 2010.
- [12] Gamess E, Veracoechea C. A Comparative Analysis of Network Simulation Tools. The 2010 International Conference on Modelling, Simulation and Visualization methods(MSV'10) Part of WORLDCOMP'10, Las Vegas, Nevada, USA. July, 2010.
- [13] Desantis M. US-Cert. Understanding of Voice Over Internet Protocol. Pp 2-3.