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Network Simulators: A Comparative Survey

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Abstract*: - Network Simulators are used to observe the performance of a network in terms of various network performance measures. While testing a scenario, it is very difficult to setup a complete network containing computers, routers and data links to see the feasibility of the network. In these circumstances, network simulators are used to set up, test and improve performance of any network. Network simulators help to accomplish this task with less time as well as less expenditure. Network simulators facilitatethe network designers to implement new networking protocols or to modify the existing protocols in a controlled and efficient manner. In this paper, we present an overview of different network simulators which can be used for simulating wired as well as wireless networks.*
Keywords: *Network simulators,NS2, NS3, OMNET++*

I. INTRODUCTION

Networking study, implementation, testing and evaluation is not feasible without Network simulation.It is a technique where a code incorporates the behaviour of a network by calculating the interaction between the different network entities (hosts/packets, etc.) using mathematical modeling. Simulators are used for the development of new networking architectures, protocols or to modify the existing protocols in aefficient environment. Network simulator provides benefits of time as well as cost saving while implementing and testing any wired or wireless network. Due to growth of communication networksand ever increasing networking speed, the role of efficient Network simulators in research field is important. A network simulator is a piece of software or hardware that predicts the behaviour of a network, without an actual network being present[1].There are various existing network simulators like NS2 ,NS3, OMNET++, OPNET, QUALNET etc. Among them some are Graphical User Interface (GUI) driven and some are command line interface (CLI) driven. Network simulator enables the designer to place various network components like nodes, servers, routers, gateways and links and plan events like packets to be sent, packets to be drooped, time intervals and various attacks. Designer can redesign or modify protocols, incorporate cryptographic operations. Network performance can be observed by various network performance measures modeled by network simulators like Bit Error Rate, Packet Drop Ratio, Quality of Service, Signal to Noise Ratio, Wavelength Utilization Ratio,Network Sharing Capacity etc.

1. NETWORK SIMULATORS:

1.1NS2**:** Network Simulator (Version 2), widely known as NS2, is an event driven simulation tool that is useful in studying the dynamic nature of communication networks. NS2 simulation of both wired as well as wireless networks can be done. NS2 provides users with a way of specifying such network protocols and simulating their corresponding behaviors. NS-2 was built in C++ and provides the simulation interface through OTcl, an object-oriented dialect of Tcl. The user describes a network topology by writing OTcl scripts, and then the main NS program simulates that topology with specified parameters. General format trace files, NAM format trace files, personalized trace files are examples of NS2 output files. NS2 provides the designer with information about network performance through network performance metrics like packets send, received, dropped, initial energy of nodes, consumption of energy for transmitting, receiving, idle power, sleep power. NAM file is a visual graphical window which illustrates the node movements, range, and packet transfer including time[2]. Simulator interface is shown in fig 1.

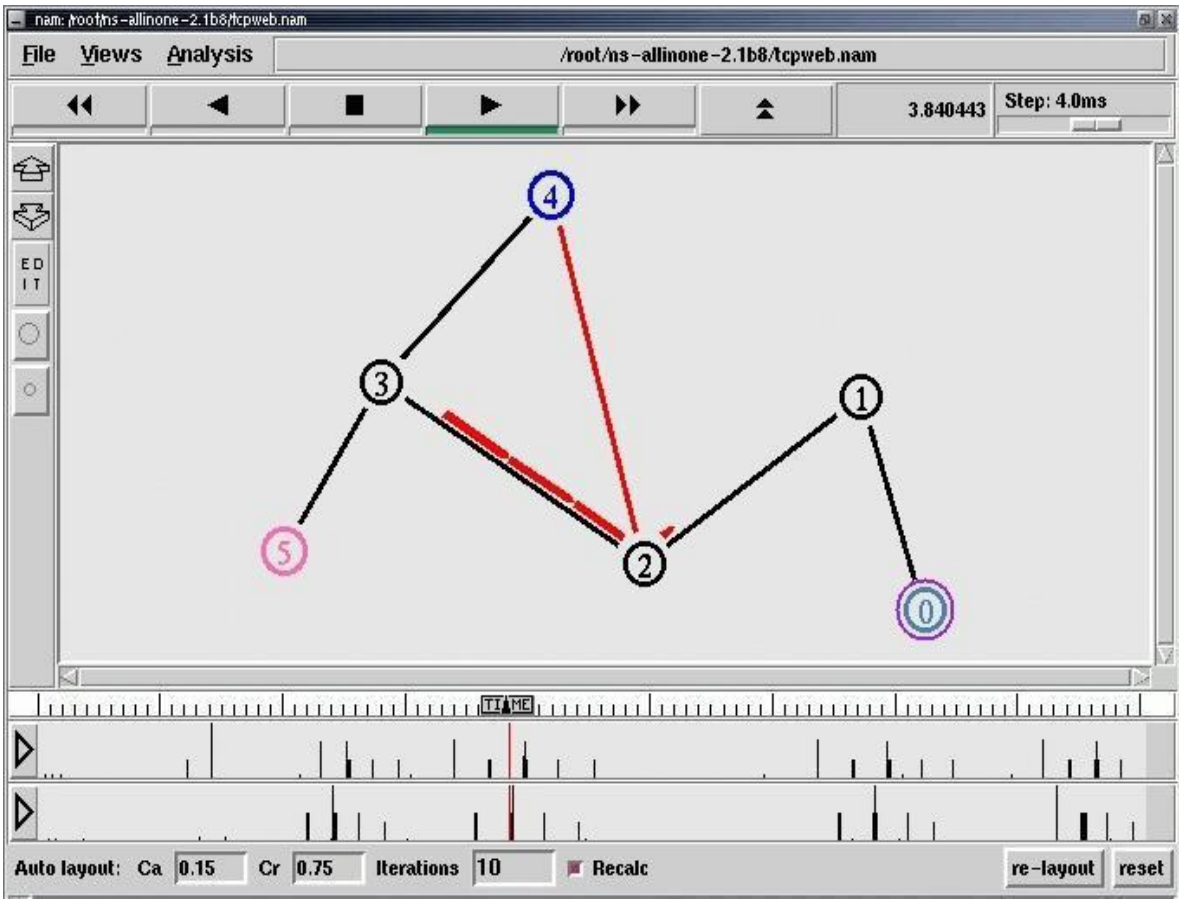

Fig 1 : NS2 simulator interface[7].

1.2. NS3**:** NS-3 is an open source, discrete-event network simulator. Ns-3 relies on C++ with an optional Python scripting API.for the implementation of the simulation models. However, ns-3 no longer uses OTcl scripts to control the simulation. It is a free, open source software. NS-3 is not an extension of NS-2.NS-3 supports both simulation and emulation us-ing sockets. It also generates pcap traces that can help in debugging. Simulator interface is shown in fig 2.The features of NS3 are New software core, Attention to realism, Software integration[2]. NS3 is based on Modular, documented core, C++ programs and Python scripting, Alignment with real systems, Software integration, Virtualization and testbed integration, Attribute system, Updated models[3].

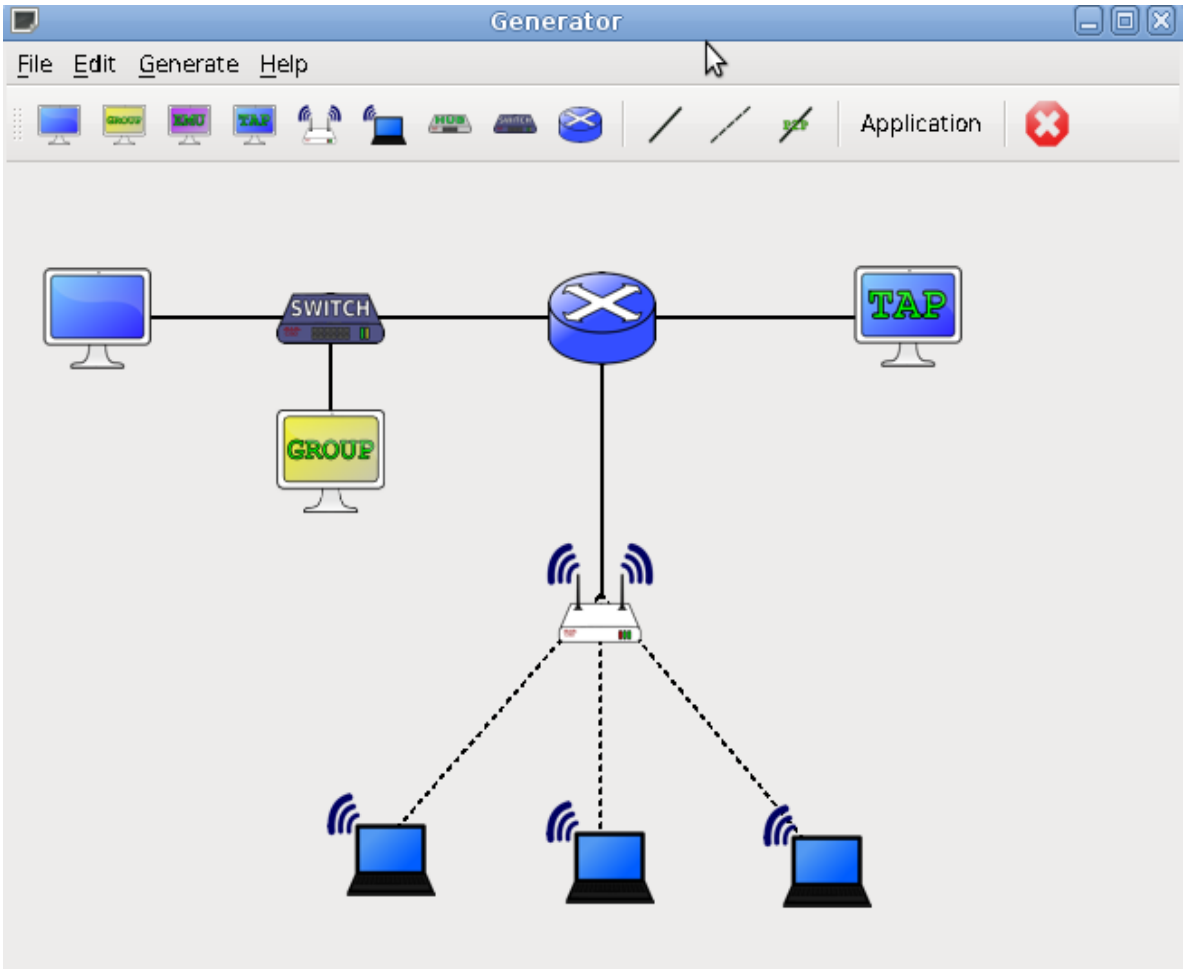

Fig 2: NS3 simulator interface[7].

1.3. OMNET++:OMNET++ is a open source, component based simulation package build on C++ foundation . OMNET++ stands for Objective Modular Network Testbed for C++. It can run on various platforms like Linux, Unix, Windows XP, Windows 7, 8. OMNet++ is composed of (1) Simulation Kernel Library (2) Compiler of Network Editor(NED) Topology Description Language (3) Command line interface (4) A model documentation tool for documentation.(5) Utilities (6)Graphical Output vector Plotting Tool (7) NED Files (8) Graphical User Interface (GUI) [4].There are two types of modules used in OMNeT++, namely, simple and compound. Simple modules are used to define algorithms and are active components of OMNeT++ in which events occur and the behavior of the modelis defined (generation of events, reaction on events). Compound modules are a collection of simple modules interacting with one another.OMNET++ has extensive graphical user interface (GUI) and intelligence support[5]. Simulator interface is shown in fig 3.

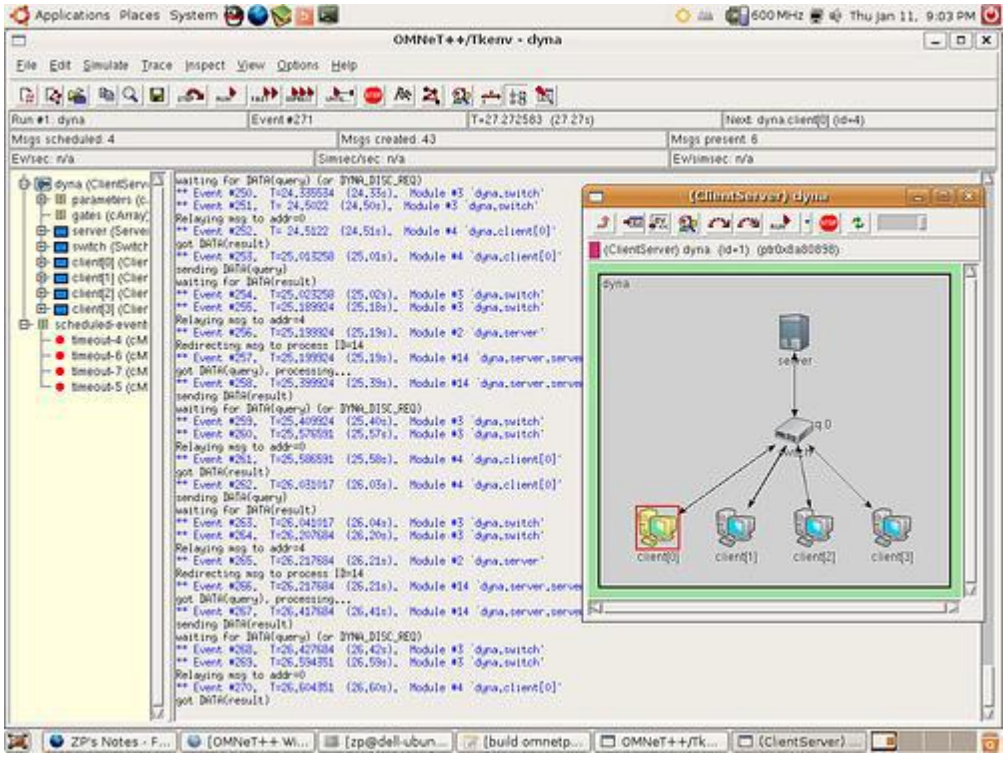

Fig 3: OMNET++ simulator interface[7]

II. COMPARISON

Attributes of NS2, NS3 and OMNET++ are compared in Table 1.

Table 1: Comparison of NS2, NS3, OMNETT++[6],[7],[8],[9]

Attributes	Tools		
	NS2	**NS3**	**OMNET++**
Simulation	Virtual	Real	Real
Computation Time	High	Low	Low
CPU Utilization	High	Low	Low
Execution	Moderate	Best	Moderate
User support	Excellent	Excellent	Good
Mobility	Yes	Yes	No
GUI(Graphic User Interface)	Limited	Limited	Good
Complexity	More Complex	Less Complex	Less Comlex
Compatibility	More Compatible	Less Compatble	Less Compatible
Memory Consumption	Highest	Lowest	Moderate
Propagaion Delay	Constant	Constant	Variable
Packet Delivery Ratio	Less	More	More
Throughput	Constant	Constant	Variable

III. CONCLUSION

In this paper three main network simulators were discussed: NS2, NS3, OMNET++. To get better and efficient result NS2 needs to be ported to NS3, otherwise OMNET++ can be considered as viable alternative. NS-3 rely on pure source code for the development of the entire simulation. The NS-2 and OMNET++in terms of open source must be the best choices in most of situation for research. NS-2 is most popular simulator for academic research but it is normally criticized by its complicated architecture. NS-2 fully utilizes the CPU, but

is able to reduce CPU utilization when other applications are executed in parallel. OMNET++ is the better choice in context of Graphical User Interface. And when scalability is the main concern, ns-3 and OMNET++ are preferred.

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