Comparative study of computer simulation software's

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Abstract

One of the methods for analyzing systems is simulation. Network simulation is a technique that models the behavior of the network by performing transaction calculations between different network entities and using mathematical formulas and taking observations from network products. A network simulator is a piece of software or hardware that predicts the behavior of a computer network without a real network. Users can customize the simulator to fulfill their analytical needs of their own systems. In the realm of research, the creation of a network, especially large networks, is difficult in a real-time scenario, and its implementation in the real world is not easily feasible and very costly. So simulators help network developers to control whether the network is capable of working in real time or not, or whether it has enough performance. This reduces the time and cost required to test the functionality of the network. In this paper, we have investigated and compared the simulation software of the network. For this purpose, 23 major network simulators are considered and the results of these comparisons are expressed in several different views in multi tables.

Keywords: Simulation, network, network simulation software, general purpose simulator, comparison

1. Introduction

Today, there are huge industrial and economic activities around the world, and factories, manufacturing and industrial centers, with workforce and the availability of the raw materials they need, sometimes operate around the clock. In the meantime, the most important thing that industry owners and service providers pay particular attention to is to optimize their activities and actions so that they can use the minimum materials and components and the required equipment to provide the highest quality products or services to provide. In another case, the owners of capital and groups that are in the early stages of entering these types of activities need to have an image of what they want to invest on, as well as the amount of utility (return) of that specific activity and general knowledge from the cycle of their desired activity. The first suggestion for this goal is a small (laboratory) sampling, which, of course, requires initial costs for a project that we do not currently have a comprehensive understanding of its problems. Network simulation means virtual simulation. The purpose of the simulation is to find problems in existing networks or locate unexpected interactions on a network that has not yet been built.

By locating or preventing existing failures, reliability can be improved and costs reduced. Other reasons for using the simulator include the lack of hardware and the consequent lack of hardware reform problems or other problems, such as the complex configuration of real-world equipment.In the field of computer research

and network communication, simulation is an important technique, because network behavior can be modeled by calculating the interconnection between different network components using mathematical formulas. Simulation can also be modeled by real or virtual recording and periodic real-time observation of real-world networks. Once the data is obtained through observations of simulation experiments, the network behavior and supported protocols can be viewed and analyzed in a series of off-line testing experiments. Also, all types of environmental features can be modified in a controlled manner to evaluate how the network can work under the combination of different parameters or configuration conditions. Comparing simulators and choosing one of them will help organizations and groups achieve the ultimate goal of each project. For this reason, we came up with a model of a list of widely used network simulators and comparing their properties, one of the ways to optimize the choice and finally speed up network access. Therefore, in this study, 23 simulators from several different perspectives including accessibility, support, component, simulation, platform, visual / visual, supported protocols, testing, main applications, prominent features and advantages, disadvantages and Constraints will be compared and we will outline the results for a better selection of network developers in the tables.

2. What is a Computer Network?

Basically, a computer network consists of two or more computers and accessories such as printers, scanners, and the like, which are directly used for the common use of hardware and software, data sources and connected devices. All hardware and software are available in the Source Network. In computer networks, according to the type of computer configuration, each computer can simultaneously utilize its resources, including tools and data, with other computers at the same time. The reasons for using the network can be as follows:

1 -Common use of resources: Common use of a source of information or computer equipment, regardless of the geographic location of each resource, refers to the use of common resources.

2 - Reducing costs: Focusing resources and sharing them, avoiding their distribution in different units, and the specific use of each user in an organization, will reduce costs.

3 - This feature refers to network support providers in the network, This means that we can provide various sources of information and systems in the second version of the network and support and if you do not have access to one of the sources of information on the network "due to system failure", use backup copies. Support for servers in the network increases the system's continuous activity and readiness.

4 - Reducing the time: Another goal of creating computer networks is to establish strong links between remote users, meaning there is no geographical limitation of information exchange to reduce the time of information exchange and the use of their own resources.

5 - Ability to develop: A local network can be expanded without changing the structure of the system and become a larger network. Here, the cost of developing a system for the cost of facilities and equipment needed to expand the network is considered.

6 - Communications: Users can exchange their messages through existing innovations such as e-mail or other messaging systems; even file transfers are possible.

3. Simulation

Simulation technology and software are one of the most powerful methods and tools available to managers, industry engineers, system analysts, and so on, which enables them to make systems, in hands, before making any decision about any production system, service, Modeling and simulating them, performing or working them, and making necessary statistical surveys in all its dimensions in order to make better decisions, with the goal of reducing costs and increasing profit (or efficiency). Using simulation, a wide range of dynamic (dynamic) issues can be analyzed in the areas of manufacturing, support, and services. The simulation allows for modeling the flow of materials and goods, human resources and information in the organization, and analyzing and analyzing the system by simulating and adjusting different scenarios, 3D animations, and ... It was concerned with potential improvements.

4. Network Simulator

A network simulator is a piece of software or hardware that predicts the behavior of a computer network without a real network. A network simulator is a software program that imitates the function of a computer network. In simulators, the computer network is modeled with devices and traffic, and then its efficiency is analyzed and analyzed. Usually, users can customize the simulator to fulfill their own analytical needs. Simulators generally support well-known protocols that are used today, such as wireless LAN(WLAN), WiMAX (WorldWide Interoperability for Microwave Access), UDP (User Datagram Protocol), and TCP (Transmission Control Protocol).

Most commercial user interface graphical user simulations. Some network simulators require the input of scripts and commands (network parameters). The network parameters define the network status (location of nodes, links (and events), data transfer, link failure, etc.). The most important output of the simulators is the tracking file. Tracking files can document any simulation event that is being analyzed and analyzed. Some simulators have added functions to capture data directly from the environment at different times of day, week, and month to show the average, worst and best modes. Network simulators provide other tools for facilitating visual analysis of trends and potential bottlenecks. Simulation of the network is difficult, for example, when there is a large congestion, the average occupancy estimate due to high variance is difficult. To estimate the network buffer overflow, the time required to respond can be increased. Specific techniques, such as variates control, important sampling, etc., which extends the simulation speed.

5. Application of Network Simulators

Network simulators solve a lot of needs, faster and cheaper than the network simulator compared to the cost and timing of launching the test bed for a large project that includes computers and routers and data links. The simulators allow engineers and researchers to simulate scenarios that are difficult and expensive to implement in real hardware with a number of ninety and new protocols tested on the network. Network simulators are useful because they allow

researchers to test network protocols or modify protocols in controlled and renewable environments. A kind of network simulator includes a wide range of network technologies and can help users build complex networks of simple blocks such as nodes and links, and can be hierarchical networks with different types of nodes such as computers, hubs, network bridges, Routers, switches, links and mobile units.

6. Network SimulationTools and Software

An important part of the development of each system is the evaluation of its performance with regard to delays and delays in different real-life scenarios. In many cases, the performance and applicability evaluation of the network is achieved through simulation experiments, which also requires a suitable environment and simulation tools. Several tools and techniques have been created in this regard. For example, an Event- driven simulation technique can be used, which is the basis of many new simulators. In a category of types of simulator software in communication networks can be classified into three main categories:

1. General- Purpose Simulation Language
2. Communication- Oriented Simulation Language
3. Network simulation software

Understanding the performance of these tools is an important step towards developing an overall methodology for generating network simulators. Therefore, the following features of the simulators are discussed below.

7. General- Purpose Simulation Language

This group generally applies to any simulation, and especially if equipped with simulator modules, network elements (nodes, links, protocols, ...) can be used as a flexible tool for this purpose. , Examples of this group include:

- ✓ SES/Workbench
- ✓ MODSuyt|M
- ✓ GPSS/H
- ✓ BoNes DESIGNER
- ✓ Arena
- ✓ SIMAN/CinemaV
- ✓ SIMSCRIPT
- ✓ SLAM SYSTEM

In the meantime, only SES and BoNes have ready-made elements for network simulation. The strength of this category of simulators is their superb flexibility, which allows the user to simulate any network with any desired protocol and the difficulty, on the contrary, is the difficulty of defining the network topology and its protocols, which requires recognition of their special programming language.

8. Communication- Oriented Simulation Language Network

These simulators are very similar to the previous one, With the difference that most of the elements required to simulate the network are pre-prepared, which, however, diminish the time required for the simulation process, but have less flexibility, OPNET Modeler software is an example of This category is.

9. Network Simulation Software

This group includes full packets that Communication- Oriented Simulator can

simulate communication networks without the need for coding and usually through graphical interfaces, the presence of simulated elements corresponding to the actual elements (routers, switches, ... (In addition to enhancing accuracy, it improves ease and speed in the simulation process, and is therefore very suitable for unfamiliar users with programming technology. COMNET III, BoNes PlanNet, NETWORK II and L.NET III Examples.

The group is successful. Altogether, professional users, especially those dealing with specific networks, prefer simulation languages with difficulty working with them, and, in contrast to users who deal with the simulation topic in a cross-sectional fashion, packets like Prefer the instrument. Network simulation tools should have the following five characteristics:

1. **Flexibility in modeling**: The user must be able to add new types of common network resources such as nodes, links, and protocols to the emulator's suite.
2. **Ease of Modeling**: The existence of graphical interfaces and the possibility of structured modeling, in the form of complex models based on simple models, as well as the ability to reuse modules from features that accelerate the simulation process.
3. **Fast execution of models**: Processing time in large simulations is important for networks with a large number of nodes, which requires proper memory management.
4. **Animation**: Graphical display of network elements that are exchanging messages with each other to solve simulation errors and understand how it works. In some simulation software, simulator runs simultaneously with the implementation of the simulator and in some others after it is performed in the form of Playback
5. **A**bility to Re-run and Repeat Simulation: The purpose of the simulation is mainly to investigate the effect of one or more parameters (average packet length or buffer capacity) on its efficiency, and therefore the repeatability is a necessary condition for these software.

In general, it should be noted that the creation of an accurate and valid network simulator requires the use of simulation technology along with network knowledge and protocols. Of course, along with the above features, there will be some capabilities on the value of each simulator, among which are the following:

- ✓ Presence of Built- in Modules modules corresponding to network elements and protocols.
- ✓ The existence of a Random- Number Generator and, in more advanced forms, the ability to create quantities with different random distributions, because most occurrences in a simulation process are of the type of random processes.
- ✓ Support for users with timely upgrades (especially for new protocols) with full documentation.
- ✓ Providing reports on network performance parameters (output rate, efficiency, transmission delay and so on) in the form of figures and curves, together with the possibility of performing statistical operations on the results of other positive features of a simulator.

NS-2 simulator

The NS-2 development was supported by the DARPA VINT project from 1997 to 2000 and was supported by SAMANDARPA and NSF CONSER from 2000 to 2004. Today,

NS-2 is the most widely used open source network simulator, and has been designed and implemented using C ++ programming language and OTCL language. OTCL is a handwritten language with the structure of TCL language writing and object-oriented capabilities. The object-oriented capabilities added to TCL at the University of MIT have been designed and implemented, and is an event-oriented simulator that is used in sensor projects and simulates IP networks.

NS-3 simulator

The NS-3 is a distinct event simulator used for research and educational purposes. NS3 systems use many components that use the "tool chain" for development. The "tool chain" software includes a set of programming tools that are available in the given environment. The NS-3 creates a dynamic or static library and connects to a main C ++ application. Because of the NS-3 simulator, hardware simulations work with each prototype. On the other hand, the NS-2 works with only a few selected protocols for hardware support. It requires a few protocols in the simulation model to implement it as a real-world implementation.

OMNET++ simulator

OMNET ++ is a network simulation framework that can compile simulations as an independent implementation program. OMNET ++ is a multi-purpose discrete event simulation for academic and non-commercial applications, open source, free and multipurpose, only the kernel of the simulator and the API of the programming interface (for writing simulations and providing components for specific application areas) does not provide anything in that module. Modules are coded in C ++ and the actual behavior of the system Configuring.

PeerSim simulator

A Peer-to-Peer simulator that focuses on the measurement capability developed. PeerSim is created for the BISON project and used by the DELIS project. The PeerSim simulator has cycle-based simulation engines. The cycle engine is simplified by ignoring the transfer layer in the protocol stack and does not have the same compatibility support. PeerSim is written in Java, so the components of the simulator and the protocols are generated with java. There is also no visualization of a simulation with PeerSim.

OPNET simulator

The OPNET technology company provides users with the ability to design and study robust and wide-ranging commercial simulation software networks with all types of TENPO telecommunication, case networks, and protocols in the network. So there is a variety of features to simulate all heterogeneous networks with different protocols. Unlike NS-2, you need to buy licenses, which are very expensive. The TENPO interface, which is open source, is simple and attractive in the new C releases, and performs tasks automatically and does not require programming from the lowest level.

JiST simulator

Researchers were having difficulty accessing simulators to perform accurate simulations with a large number of nodes at logical time, so JiST was developed to overcome this problem. JiST is a simulation of a new Java-based discrete event with a number of unique and unique design features that integrate previous systems and linguistic methods. The key objective of JiST is to create a simulation system that can simulate discrete event simulations both

efficiently and transparently in the standard runtime range.

SLAM simulator

SLAM is based on the Fortern language. It is possible to use this language in network models, discrete event models, continuous event models, and a combination of these three models. SLAM is an acronym (simulation language for alternative modeling). Due to the ability to combine network models, SLAM allows discrete and continuous events to allow the user to develop other models.

Packet Tracer simulator

Packet Tracer is a powerful network simulator that can be freely distributed to universities and students in CCNA ™ (Cisco Certified Network Associate) and CCNP ™ (Cisco Certified Network Professiona) training courses. The main goal of this simulator is to enable students and professors to learn the basics of the network in terms of Cisco's specific capabilities. Packet Tracer is a Cisco network simulator that can be used not only in education, but also can simulate simple computer networks and is free to use for Cisco Student professors.

GNS3 simulator

The GNS3 simulator is a free computer simulator that provides a simulation environment using Cisco input and output images. The GNS3 is open source network simulation software that tries to close real networks and does not require the physical hardware of the network. Has a graphical environment for building complex networks. Based on the Dynamic code, it provides the ability to run Cisco IOS on the computer instead of running it on the computer.

Omnet simulator

The Oment software is the only software that is available on all the word-of-mouth networks and is packaged. For each network, such as the Mixim Mesh Networking Network, the Mixim Sensor Network and Castalia, the inter-car network that works very well on the iCanCloud Cloud Computing Network, this is a graphics card or any other network. The Oment software is the only software that is available on all the word-of-mouth networks and is packaged. OMNeT is an object-oriented simulator of network events. This simulator is based on piece, modular and open architecture of discrete events. These characteristics make the network easier to design, troubleshoot and rebuild.

GPSS / H simulator

GPSS was built in the early 1960s. GPSS III is the third version of this language, a two-part program that requires collaborators. The first part is a montage program that converts system descriptors into second part data. Part II performs the simulation. GPSS III does not require programming in its usual sense. The system model is made using rectangular recipes.Using GPSS does not require prior knowledge of computer programming.

DYNAMO simulator

Dynamo has been designed to analyze the comprehensive behavior of industrial systems in large scale. Dynamo is a computer program whose model is represented as a descriptive equation set. Then, the behavior of the system is simulated by continuous evaluation of the equations over time. It is used effectively in modeling, econometrics and simulation of complex industrial systems as well as in the planning of social urban systems.

GASP IV simulator

It was created in 1973 and replaced by the GASP II language, a language of the simulation of discrete variables. The major difference between GASP II and GASP IV is the additional ability of GASP IV to simulate continuous variables in addition to discrete variables. This language has the ability to execute a combination of continuous and discrete variables and is written in Foreton IV and can be used in any computer with Fortern's partner. The programmer can modify GASP IV and match it with your favorite features that are not included in the program.

SIMSCRIPT simulator

In the early 1960s, SIMSCRIPT created Harry Markowitz at Rand as a programming language. Although initially designed for simulation analysis, it can be used as a language for general and general purposes. This language is a powerful simulation language that does not use English words and does not require any special coding and does not need to use it in an intermediate language such as Fortern.

Q-GERT simulator

This language is suitable for network modeling, especially queuing system analysis. GERT is an acronym for the evaluation and review technique using the chart. The major difference between Q-GERT and GERT is that Q-GERT has the ability to enter service providers in the network model. In addition, the user (user) allows tracking specific input paths over the flow of the system. From the languages introduced here, Q-GERT is the simplest simulation language for users.

Arena simulator

ARENA is very suitable for simulation animation and graphic modeling.This program allows the user to create modeling objects called cajoles, which are the cornerstones of the model. All components of a process including logic, data, animation and statistics collection can be modules to specify the process that entities pass through. ARENA is capable of making animations by providing patterns. Patterns are a set of modules that incorporate entities, processes, and vocabularies into a specific type of problem, and models for reengineering business processes, telephone centers, high-speed manufacturing, manufacturing, semiconductors, and many other applications.

CloudSim simulator

CloudSim is a framework for modeling and simulating cloud computing infrastructures and services. In fact, the main purpose of this is to create an expanding and generalized simulation framework that enables integrated modeling, simulation and testing of emerging cloud computing infrastructures and application services.

GloMoSim simulator

GloMoSim is a simulation environment used to simulate wireless and wired mobile networks and is made up of modules in different layers. Each of these modules simulates a protocol in a protocol stack.

9.19 J-Sim simulator

This simulator, with the old name, is JavaSim Simulation, implemented at the highest level of component-based architecture software, called Independent Components Architecture. Base entities in the architecture of the stand-alone components are components that interact with each other by sending and receiving messages from / to their respective nodes.

OptSim simulator

Simulation software is used to design and simulate visual communication systems at the signal emission level. According to simulation techniques, this software is an easy way for a graphical user interface and a quasi-experimental scale instrument, which brings us to unparalleled results in accuracy and use.

QualNet simulator

A design, testing, and practice tool that simulates the behavior of the real communication network. QualNet provides a comprehensive framework for designing protocols, creating and deploying network scenarios and evaluating performance.

REAL simulator

The simulation is used to study the dynamical behavior of flow control and congestion in packet networks, allowing its users to recognize the networks and simulate their behavior.

AVRORA simulator

AVRORA is an emulator and analyzer of written programs for AVR microcontrollers. This simulator has a flexible framework and it is recommended to use this software to simulate sensor networks.

10. Compare and evaluate tools and languages for network simulation

With the growing spread of research and simulation tools, many tools have been developed, and since familiarity with single simulators is time consuming, choosing the right simulator can be very important. Therefore, researchers have evaluated and compared the various network simulation tools to help users decide on the useful simulator. Since the model correction process is cheaper than real implementation, a wide range of scenarios can be analyzed at low cost. Therefore, several important simulators have been investigated and compared.

Table 1 (Accessibility: open source or commercially available simulation software) is meant.

Table 2 (Support): It is possible to check the guide, source code, examples, ease of access to the certificate and simulation documents.

In table (3) the component is the language used by the simulator software.

Table (4) Simulation Mode: Has metrics of performance such as synchronization / asynchronous, single / multi-threaded, separate event / track-based axis.

Table 5 (platform): The software platform features of each simulator are listed.

In Table (6) (Visual / Visibility): The graphical display quality of the models examines the interface, graphical application and graphical presentation of the final result.

The protocols supported in Table 7 (supported protocols are OSI (Open Systems Interconnection) protocols) are meant.

The purpose of the test is in Table 8 (Testing: Ease of testing a computer program).

Table 9: Main application cases: The purpose of a particular simulator is simulation designed for a specific purpose, and the purpose of the general simulator is the simulator used extensively and in various laboratory situations.

In the table (10), the features and benefits: the features and benefits are prominent features that make the simulator differentiate and excel.

Table 11 (Disadvantages and Limitations: Limitations are the limitations that users use when using the simulator.

Table.1. Accessibility

Accessibility	Opnet modeler	NS-2
	• Commercial software(has no public access)	• Open source software (including source code and tests and examples)
	J-Sim	GloMoSim
	• Open source software (with available code and examples)	• Open source simulator (included below .bin)
	CloudSim	GNS3
	• Open source simulator (includes package, class, and example)	• Open and free simulator
	NetSim	NS-3
	• Commercial simulator (includes free demo)	• Open source software (including source code, tests, and examples)
	Packet tracer	OMNet ++
	• Free and open source software	• Free software only for scientific and nonprofit use
	OptSim	AVRORA
	• Business simulator up to 1998 (now free in academic cases)	• Open source simulator (online access to documents)
	REAL	QualNet
	• Open source simulator	• Commercial version of the GloMoSim simulator

Table.2. Support

Support	Opnet modeler	NS-2
	• Have an excellent guide • Mailing list (maintenance license required • Source code and examples	• Have a good guide • Public access to a license or license to use the software • Source code and examples
	J-Sim	GloMoSim
	• Have a good guide • Public access to the certificate • Source code and examples	• Ability to expand and add new code • Predefined library components • Public access to the certificate
	CloudSim	GNS3
	• Have an excellent guide • Access to API[1] documents • Source code and examples • Certification access • Access to .jar NS-3 NetSim files	• Have an excellent guide • Limited Certification
	NetSim	NS-3
	• Simulation engine • Graphical applications • My SQL databases • A laboratory menu includes training, routing protocols	• Have an excellent guide • Access to shared code page • Access to library documents • Access to API documents
	Packet tracer	OMNet++
	• In-service tutorials • Public access to the certificate	• Have an excellent guide including a programming guide • Has a library of simulation classes
	OptSim	AVRORA
	• A wide library of models, standard components and parameters accurate	• Access archive to previous projects • Lacks active support • Access a large amount of information through the help option • Online documents
	REAL	QualNet
	• Ability to use new modules • Accessibility from the main server • Excellent guide • Online documents	• Documentation and Standards Library • Certificate of Product Extensibility • Annual support and maintenance contract • Access to new releases and software certification

[1] application programming interface

Table.3. components

components	Opnet modeler	NS-2
	• C /C++	• OTCL (higher level) and C ++(lower level)
	J-Sim	GloMoSim
	• Java	• ParSEC[2]
	CloudSim	GNS3
	• Java	• Dynamips
	NetSim	NS-
	• C++	• C ++ (higher level) and Python(lower level)
	Packet tracer	OMNet++
	• Cisco Input / Output Instructions	• C ++ and NED[3] (Model Structure)
	OptSim	AVRORA
	• C++ / C	• Java
	REAL	QualNet
	• Scenario (and C) Modulated Structure .NET)	• C++

Table.4. Simulation Mode

Simulation Mode	Opnet modeler	NS-2
	• Synchronized, single-threaded, queue-based, and fast-ended, absolutely definitive • Multi-threaded, queuing-based event, distributed simulation And HLA[4] • Simultaneous 32-bit and 64-bit simulation core	• Sync, single-threaded, queue-based off-the-shelf event, absolutely definitive, version Available Distributed and Parallel
	J-Sim	GloMoSim
	• Sync, single-threaded, fully-definite, multi-threaded, based on processes with Real-time, non-deterministic, component-oriented architecture	• Simulate a separate parallel event • Use of synchronous and asynchronous algorithms • Multi-threaded
	CloudSim	GNS3
	• Separate event	• Separate event
	NetSim	NS-3
	• Multi-threaded with Net Engine simulation core	• Separate event
	Packet tracer	++OMNet
	• Use the time-out model	• Separate event • Object-oriented and component-based modules
	OptSim	AVRORA
	• Separating the domain time and frequency range	• Separate event
	REAL	QualNet
	• threading directly and intolerably	• Distributed and parallel simulation

[2] Parallel Simulation Environment for Complex Systems
[3] Network Description
[4] High Level Architecture

Table.5. platform

platform	Opnet modeler	NS-2
	• Windows و LINUX)X 86(	• Windows و UNIX و Linux
	J-Sim	GloMoSim
	• Linux و Windows) XP،NT و(eComStation و OS2 Wrap4 و Solaris 8 (100% portable)	• UNIX و Windows و Linux)ubuntu و fedora(
	CloudSim	GNS3
	• LINUX)ubuntu و (Windows 7	• Router platforms for Cisco and Linux, Windows and Mac
	NetSim	NS-3
	• Windows و linux و unix	• Linux و Mac و Free BSD
	Packet tracer	OMNet++
	• Windows) XP، Vista،7 و (Linux) ubuntu ، fedora(	• Linux and pseudo-UNIX and Windows systems (XP, Win2k)
	OptSim	AVRORA
	• Windows و Unix و Linux	• Mica2 and Mica Z independent operating systems
	REAL	QualNet
	• Unix و BSD 4.3 و Solaris و Ultrix و Free BSD وSun OS و IRIX	• Windows و Linux

Table.6. Visual / Visibility

Visual / Visibility	Opnet modeler	NS-2
	• Advanced graphic interface	• Lack of graphics output in the original version of the simulator • Added visualizer to eliminate the text-based interface •
	J-Sim	GloMoSim
	• 2 user graphical interfaces and use Console	• Visual programming for the visual design of the ParSEC program
	CloudSim	GNS3
	• Graphical interface for reading network topologies • Have graphical tools	• Simple and general graphical interface (includes everything)
	NetSim	NS-3
	• Have graphical applications	• View simulation result using NAM animator
	Packet tracer	OMNet++
	• Graphical interface with multi-language support, has two logical topologies And physics along with improved multi-user environments	• Graphical user interface for execution • Support for strong graphical interface
	OptSim	AVRORA
	• Visual simulation of communication systems • Interface with 3D tools, Liekki design software, visual vector analysis • Inner visual connections	• it has a control flow graph for graphical representation of program instructions to understand the structure and understand how the code is compiled. No graphical interface • No graphical interface
	REAL	QualNet
	• Graphical interface written in Java to create faster simulation scenarios	Graphical design of a network model using libraries • by the QualNet animator

Table.7. protocols supported

protocols supported	Opnet modeler	NS-2
	• TCP / IP /ATM • FDDI / 6Ethernet • Frame relay • Protocol 802.11 • Wireless protocols	• TCP/ UDP • FTP / Telnet and other web protocols in fixed and variable bit rate users • 802.11 and TDMA[5] MAC layer protocols • Routing and multiprocessing protocols and, in general, all layers
	J-Sim	GloMoSim
	• Routing protocols such as RPSG[7] and AODV[8] • Protocols used in wireless lines and single networks	• Provide a protocol stack that includes models for channel, radio, MAC, network, transmission, and higher layers. • Simultaneous protocols and wireless networks
	CloudSim	GNS3
	• Open flow	• OSPF[9], Ethernet and STP[10] protocols
	NetSim	NS-3
	• Aloha/ Slotted Aloha / Ethernet • CSMA/CD • Fast Ethernet/Gigabit Ethernet • Token Ring/Token bus در WLan • ATM و TCP/ RIP • OSPF, BGP, MPLS, ZigBee 802.15.4 • Wimax / Wireless Sensor Networks	• Routing protocols such as HWMP[11] and FLAME [12] • Management Protocol • MAC layer routing protocols • TCP / UDP / Wimax
	Packet tracer	OMNet++
	• Application layer protocols (DNS, HTTP, etc) • Network layer protocols • Transmission layer protocols • Access / Interface protocols	• UDP / IP and ICMP • Transfer Protocol and MAC protocols • Stop and wait protocol • Some local protocols for wireless sensor networks
	OptSim	AVRORA
	• Random or fixed access protocols • Reservation protocols • High-speed communication protocols • MAC protocol • TCP / IP (most of the transmission and network protocol protocols	• MAC layer protocols in wireless networks
	REAL	QualNet
	• Flow control protocols (TCP and…) • Transition layer protocols	• Has a protocol stack • Routing protocols • Messege protocol and wireless, wired and widespread networks

[5] time division multiple access
2 Fiber Distributed Data Interface
[7] Greedy Perimeter Stateless Routing
[8] Ad-hoc On-demand Distance Vector
[9] Open Shortest Path First
[10] Spanning Tree Protocol
[11] Hybrid Wireless Mesh Protocol
[12] Hybrid Wireless Mesh Protocol

Table.8. purpose of the test

purpose of the test	Opnet modeler	NS-2
	• Testing technology design in real scenarios • Test user scenarios for the correct functioning of the new network to join the central network	• Testing the main platform of this simulator (VINT project) • Apply daily validation tests to NS-2 and send to NSNAM
	J-Sim	GloMoSim
	• Design, create and test the unit of each component in this simulator	• Test routing algorithms
	CloudSim	GNS3
	• Testing cloud networks due to limited test bed scales • Service testing of user generated networks in a controlled environment • Use of test methods and faults to fix defects • Has a library package test	• Virtual network testing
	NetSim	NS-3
	• Test quick connectivity in K-NetSim (Test connections between network equipment and protocols.)	• A unit test to inform the user of the correct simulator functionality (in parallel with the help of WAF)
	Packet tracer	OMNet++
	• Test in the Activity Wizard section of this simulator	• Test and debug simulation of users by a strong graphical user interface
	OptSim	AVRORA
	• Laboratory testing of equipment such as agile • Test component features such as L-I curves for laser models and so on	• Test the program before placing on the hardware by the user • Use GDB debugging for development and testing
	REAL	QualNet
	• Testing scenarios in non-stress conditions • Output scenario testing of this simulator in a large amount of workload	• Network communication testing • Test network connectivity features by users

Table.9. Main application cases

Main application cases	Opnet modeler	NS-2
	• Design, deployment and management of infrastructure, equipment and network applications • Use in the design and study of communication networks, equipment, protocols and applications and wireless environments	• General simulator • Use in network research and simulation of IP networks • Uses for scalable wireless and wired network simulation
	J-Sim	GloMoSim
	• Modeling systems to apply distinct changes in objects • Provide all Java language features • Use in wireless and sensor environments	• Uses in wireless and wired mobile networks, and in particular the simulation of parallel wireless networking
	CloudSim	GNS3
	• Modeling and simulating infrastructures and cloud computing	• A tool for configuring and checking the network to participate in Cisco Exams
	NetSim	NS-3
	• Use in experiments and research in network labs • Development in order to study security technology and support for cyberspace exercises	• Use in research and education issues in wireless and wired networks
	Packet tracer	OMNet++
	• Use CCNA and CCNP training courses to create an unlimited number of network equipment and debug these networks without the use of real switches and routers.	• General simulator • Wired and wireless communication networks, protocols and queues in the network • Modeling distributed hardware systems • Validation of hardware architecture • Assessing the performance aspects of complex software systems • Modeling and simulating event systems - distinct
	OptSim	AVRORA
	• Visual simulation of communication systems at the signal emission level	• Use in wireless sensor networks
	REAL	QualNet
	• Use to study dynamic behavior of flow control and congestion in networks	• Design protocols • Creating and mobilizing network scenarios • performance evaluation

Table.10. features and benefits

features and benefits	Opnet modeler	NS-2
	• Hierarchical Modeling Environment • The fastest discrete event simulator engine among upcoming industrial solutions • A complete library of Opnet models • Grid grid computing support for distributed simulation • Integration, debugging, graphical user interface and analysis	• Ability to add new protocols and public access to them • Object design and the ability to create protocols and use them • Features in sensor networks including sensor channels, battery models, low-power protocols • Perform simulations at the closed level, resulting in more precise results
	J-Sim	GloMoSim
	• Supports energy modeling with the exception of radio power consumption • scalable • Simplified equipment models	• Quick integration of models developed in different layers • Use in a parallel development environment • Ability to develop • Run by a large set of synchronization protocols • Run in two types of shared or distributed memory systems
	CloudSim	GNS3
	• Supports modeling and simulation of large-scale cloud computing data centers, energy-conscious computing resources, federal clouds • Support for dynamic insertion, stop and resume simulation • Supports user-defined systems • Optimizing the cost of access to resources focusing on improving profit	• An excellent complementary tool for networking • High-quality design of complex network topologies • Real-time simulated virtual network communication • Receive packets using the wireshark protocol
	NetSim	NS-3
	• Simple and understandable user interface • Learning concepts and not engaging users by choosing unnecessary devices • Implement password recovery • Implement Telnet between devices • Simple display of routing table • Build and upgrade the lab by the builders • Simulate network traffic using virtual packet technology	• Ability to add new protocols • The software core written in C ++ and the Script interface in the Python language • Attention to realism and the approach of design to real systems • Software integration • Customize the output without rebuilding the network core
	Packet tracer	OMNet++
	• Powerful simulation • Interoperability, writing and simulation evaluation • A combination of real simulation and configuration experience • Supports HSRP[13]	• Has a compiler for the NED topology description language • Network graphic editor • Command line interface to run the simulation • Simulation management facilitating tools • Creating an Infrastructure for writing various simulations
	OptSim	AVRORA
	•	• Managing networks with 10,000 nodes (at speeds of around 20 times the speed of other simulators and precision with accuracy) • Validation of independent network time features • A scalable and accurate simulator for hardware platforms in sensor programs • Implementation of sensor network along with precise timing • Ability to connect programs with radio
	REAL	QualNet
	• ability to add different modules • Ability to test and configure the simulator as needed • Custom design and production • Uses for analyzing TCP, FIFO, and ... protocols.	• Designing a new prototype and optimizing the old model • Network Performance Analysis • Features speed, expandability, reliability, portability, expandability • Remove the implementation limit of just one protocol at a time

[13] Hot Stand by Routing Protocol

Table.11. Disadvantages and Limitations

Disadvantages and Limitations	Opnet modeler	NS-2
	• Limit the accuracy of the results to the sampling resolution • Inefficient in the absence of the event for a long time • Missing laboratory guides	• Supports two wireless MAC protocols: 802.11 and TDMA • Lack of user-friendly package due to text-based interface • Need advanced skills to do the right simulation • Unavailable customization • Lacks a functional model
	J-Sim	GloMoSim
	• Low performance • Supports a MAC wireless protocol: 802.11 • Unnecessary overhead at runtime	• Limited to IP network due to low level design assumptions • No support for adding new protocols • Limited to package formats and energy models
	CloudSim	GNS3
	• Limit testing to the test bed scale • Reproduce the problem of results	• Requires Cisco Input / Output images • Change the required CPU resources dynamically
	NetSim	NS-3
	• Supports 47 different Cisco devices • Supports 200 devices on network topology	• Lack of available models • Lacks a graphical interface for creating topology • Has a laboratory-level visibility capability
	Packet tracer	OMNet++
	• Inappropriate for modeling production networks • Has technical limitations other than Cisco	• Lack of sufficient number of available protocols
	OptSim	AVRORA
	• Limit on the Demo of this simulator, such as the failure to modify Schematic simulations, the failure to create individual simulator schematics, the lack of storage of graphical objects, the absence of user-defined models or model details.	• Failure to model the Clock output change • Inability to model mobility
	REAL	QualNet
	• The limitation of simulation time to cases such as protocols	• Reduce personalization due to some tools

This research focuses on networking tools and simulators in accordance with the features presented in the above tables, because it seeks to compare tools and simulators that speed up work, reduce errors, increase the level of abstraction and reduce complexity. In the table below, these features and parameters are also compared in short.

Conclusion

This article reviews and compares the tools and simulators of the network. The research shows that this kind of simulator is due to network control to determine whether the network is capable of working in real time or not and has the capacity to reduce the time and cost required to test the functionality of the network. In this paper, we tried to compare and compare tabular characteristics and application of the 23

common simulators. Since the use of a network simulator can be effective in the performance of a project and other important issues in a laboratory research, depending on the specific characteristics of each simulator, the use of each of its types can vary depending on the application.

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