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Network Simulation Software – Uses and limitations

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Introduction

Network simulation can be described as analyzing how the network behaves. To understand the dynamics that exist in various networking protocols, there is a need for us to understand extensive scale network simulations. The network simulation technique is highly regarded as the primary tool for analyzing large networks. Simulation can be applied in other fields like biology, physics, chemistry, economics, social sciences, and even finance. The application of simulation technology into the field of networking is relatively new, and the majority of the studies being done use packet-level simulation. This simulation is limited to modeling just a hundred and thousands of network nodes, routers, and host computers (Kabir et al., 2014). The various benefits of network simulation include helping us to gain knowledge regarding the improvement of the networking system, helps us to understand the working of the system, and it also helps in evaluating the design of a new protocol (Kabir et al., 2014). Simulation can also be used in predicting the behavior of a given protocol and the various mechanisms of different conditions of a network. In some cases, simulation can help understand the effects of a new protocol, application, and networks when used effectively on large networks.

There exist several both open source and proprietary network simulators. Network simulators are being used by individuals from different fields like academic researchers, quality assurance, and industrial developers to help simulate, design, and analyze the performance of various network protocols. Some of the most famous network simulation software include NS (open source), OPNET (proprietary, NetSim (proprietary) (Raja, 2018).

Packet level simulation simulates the transmission and how queuing of individual packets travel throughout the network nodes from the source to the destination node. Packet level simulation is mainly applied in protocol design and evaluation The main tools that apply network-

level simulation include ns2, GloMoSim, Qualnet, and Opnet. The simulation of an extensive network can be executed using existing network simulation techniques which include discrete events simulation and parallel discrete event simulation. Separated event simulation included modeling the operation of the system information of a separated sequence of events where by each event happens at a certain moment right on time. There is no more change in the system among successive events. Hence the simulation can run directly from one event to another.

The USSF simulation is based on Time Warp technology built on top of the WARPED parallel discrete event simulator. It is used to simulate large-scale network systems which have over 100,000 nodes. The majority of modern simulators follow the discrete event simulation procedure. Below I discuss some of those simulators which apply discrete simulation techniques.

Optimized Network Engineering Tools (OPNET) – they are one of the most famous tools and commercial simulators because they are widely used in the industry. The OPNET environment is mainly optimized for network development and research. The tools offer powerful graphical and visual support for its users, and it used the discrete event technique.

Network Simulator 2 (NS2) – it is an open-source network simulator that is mainly used in the academic field because it is open source and it has a lot of component libraries. NS2 is object-oriented, and it is a discrete event-driven simulator. It uses the C++ language and Tcl programming language.

Network Simulator 3 – is open-source, and it uses discrete-event network simulator, and it is mainly used for research purposes. It puts its emphasis on documentation tasks. The main features of NS3 are that it uses a different software core, it pays attention to realism and it supports the integration of other open-source networking software (Bilalb et al., 2013).

Key Issues

As discussed above, network simulation is powerful and has several applications however; it has its own limitations. In the history of network simulation, there have many obstacles in its evolution. The constant improvement and increase in computational power have helped solve some of the known obstacles, although some of those obstacles still exist (Bilalb et al., 2013). Different network simulators use different approaches in dealing with the limitations hence their performance and reliability differ. Below are some of the common limitations of the common network simulators.

The first challenge is simulation credibility because all the aspects of reality cannot be implemented in a simulated environment; hence some compromises need to be made. Some of the compromises include lowering the level of the simulation detail or excluding some aspects of the network. Network simulation will be only effective if the behavior shown in the simulation environment is compared to the entire network. Hence the designer of the simulation environment cannot assure a complete simulation of the real network.

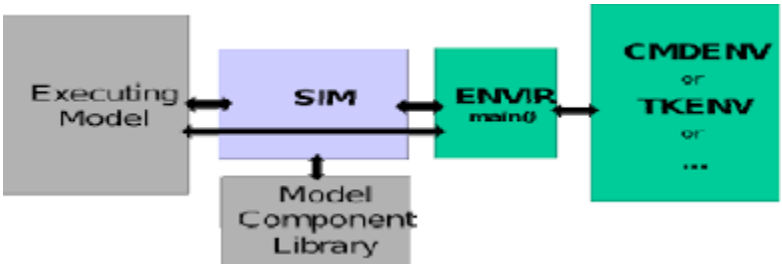
The second challenge is the simulation of upper layer functionality. The majority of simulation designers do not always develop all the functionalities from zero. The designers rely heavily on the existing models. Even the validated models can show wrong behavior or failure. Validating a model is an improvement, but it does not guarantee there the simulator will not malfunction or the presence of certain features. Also, some models implement all the components of a network, but that is no guarantee that every aspect of its behavior does not divert from how the protocol will behave in a production environment.

Another challenge that networks simulators face is the challenge of scalability limits. One of the main benefits of simulating a network is the addition and removal of components, channels, and even devices. In theory, a simulation does not have a limitation on the number of devices and the data transmitted. There are two factors that are a limitation to the scalability of network simulators. The first factor is memory usage, and the second factor was the required computation time. Every node within the simulation environment requires memory to run; hence the number of nodes will be limit to the amount of space available (Datyey et al., 2018). The only way to improve scalability is through the usage of parallel computing for all the processing events. For parallel execution of network, simulation requires to focus mainly on reducing the amount of information that is sent in the simulation environment.

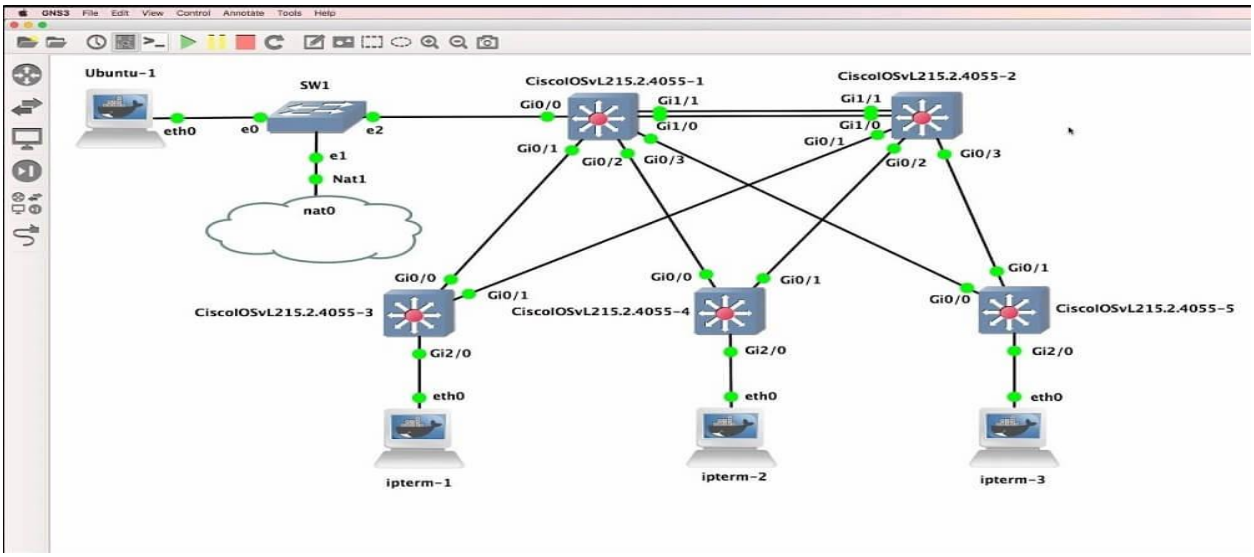
Rapid and unpredictable change in the networks is another challenge that is making it difficult to model and be able to simulate networks. The unpredictable changes can render innovations or research obsolete before even they have been finished being implemented. There is a lot of unpredictability in matters like pricing structures, scheduling, wireless technology, improvements done on devices, native multicast differentiated service, and ubiquitous web-caching (Bilalb et al., 2013). This unpredictability makes it difficult for designers to implement certain features into the simulators.

Diagrams

Flow chart



Network simulation Environment



Network simulation Environment

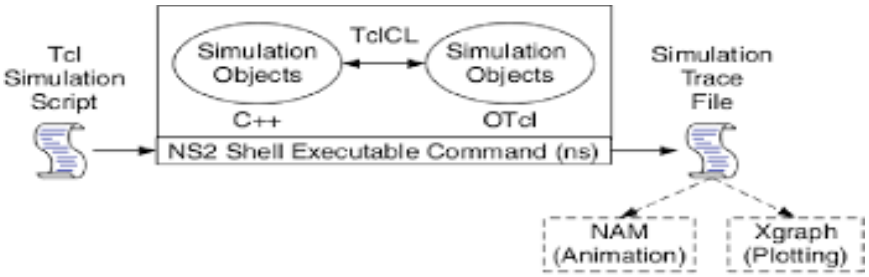


Fig 1. Basic architecture of ns-2

Conclusion

In this paper, I have discussed the network simulators and the various network simulators, and various models which are used in the creation of network simulators. The paper has also discussed various network simulation tools which are often used for a standard network. The paper also discusses network simulator techniques like discrete events and parallel discrete simulations. The paper also discusses the common network simulators like OPNET, NS2, OMNET, and NS3. The paper also discussed the various features which each network simulator has and the various improvement which can be done on the simulators. In the key issues section, the paper has discussed the various key issues which network simulators. The problems include scalability of network simulators; there was also an issue regarding the validity of network simulators because the majority of network simulators were unable to imitate the real internet hence making it hard for them to be validated.

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