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Comparative Study Of Ns2 And Opnet Simulator For Aodv And Dsr Routing Protocols In Manet

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ABSTRACT

Now a day's Wireless communication system is on trend. Next invention of wireless communications will take in both infrastructure and infrastructure-less known as mobile Ad hoc networks (MANETs).MANET is a self-configured infrastructure-less network, which contain electronic nodes or devices without any fixed access point or base station. MANET has no any fix topology, because its nodes are movable. In this network, all nodes are work as host and also as router. Routing is an important part of MANET because of the limited radio propagation range and frequently varying of topology. Several On-demand routing protocols are proposed for MANET. These include AODV and DSR protocol. These two protocols are most famous and appropriate protocols used in general way. So that here uses these routing protocol for the work. We are using End-to-End Delay, PDF, Packets loss and Throughput performance parameters for analysis.

This work is started for analysis of simulators used for MANET routing protocols. Work is done for two simulators NS2 (Network Simulator 2) and OPNET Modeler 14.5.

We concluded that OPNET is better than NS2. OPNET is user friendly in nature, and can easily run on Windows, which is generally used in environment. And it only require Visual Studio .NET and C++ libraries. An unknown person can also work on it without more difficulties.

KEYWORDS: MANET, AODV, DSR, NS2, OPNET

1. Introduction

MANETs are infrastructure-less, self-organizing, rapidly deployable wireless networks, they are highly suitable for applications involving special outdoor events, communications in regions with no wireless infrastructure, emergencies and natural disasters, and military operations [1].

An ad-hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any stand-alone infrastructure or centralized administration [2]. Mobile Ad-hoc networks are self-organizing and self-configuring multi-hop wireless networks where, the structure of the network changes dynamically. This is mainly due to the mobility of the nodes [3]. Nodes in these networks utilize the same random access wireless channel, cooperating in a friendly manner to engaging themselves in multi-hop forwarding. The node in the network not only acts as hosts but also as routers that route data to/from other nodes in network [4].

Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. Routing i n ad-networks has been a challenging task ever since the wireless networks came into existence. The major reason for this is the constant change in network topology because of high degree of node mobility. A number of protocols have been developed for accomplish this task. Routing is the process of selecting paths in a network along which to send network traffic. In packet switching networks, routing directs packet forwarding, the transit of logically addressed packets from their source

toward their ultimate destination through intermediate nodes.

An ad hoc routing protocol is a convention, or standard, that controls how nodes decide which way to route packets between computing devices in a mobile ad-hoc network [5].

In ad hoc networks, nodes do not start out familiar with the topology of their networks; instead, they have to discover it. The basic idea is that a new node may announce its presence and should listen for announcements broadcast by its neighbours. Each node learns about nodes nearby and how to reach them, and may announce that it, too, can reach them.

2. Classification of MANET Routing Protocol

Routing protocol in MANET can be classified into several ways depending upon their network structure, communication model, routing strategy, and state information and so on but most of these are done depending on routing strategy and network structure [5, 6 and 7]. Based on the routing strategy the routing protocols can be classified into two parts: 1.Table driven and 2. Source initiated (on demand) while depending on the network structure these are classified as flat routing, hierarchical routing and geographic position assisted routing [6]. Flat routing covers both routing protocols based on routing strategy.

Routing protocols for mobile ad-hoc networks can be broadly classified into two main categories:

2.1 Table Driven Routing Protocols (Proactive)

Proactive or table-driven routing protocols attempts to maintain consistent and up-to date routing information from each node to every other node in the network. These protocols require each node to maintain one or more tables to store routing information, and they respond to change in network topology by propagating route update throughout the network to maintain consistent network view [8]. Certain proactive routing protocols are Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), Global State Routing (GSR) and Cluster-head Gateway Switch Routing (CGSR).

2.2 On-Demand Routing Protocols (Reactive)

In reactive or on demand routing protocols, the routes are created as when required. When a source wants to send to a destination, it invokes the route discovery mechanism to find the path to the destination. This process is completed when once a source is found or all possible route permutation has been examined. Once a route has been discovered and established, it is maintained by some form of route maintenance procedure until either the destination becomes inaccessible along every path from the source or route is no longer desired [8]. Certain proactive routing protocols are Ad-hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA), Associatively-Based Routing (ABR), Signal Stability Routing (SSR).

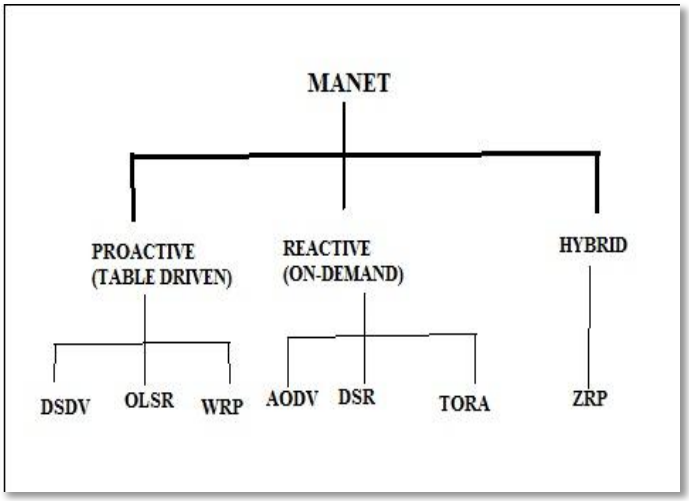


Figure-1: Classification of MANET routing protocol

In this paper two ad-hoc routing protocols are used, AODV and DSR. AODV and DSR are Reactive (On demand) Routing protocols.

3. Overview of AODV And DSR

3.1 Ad Hoc On-Demand Distance Vector (AODV): The AODV [8] algorithm enables dynamic, self-starting, multi-hop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active [9]. The AODV is a distance vector routing for mobile ad-hoc networks. AODV is an on-demand routing approach, i.e. there are no periodical exchanges of routing information. It offers quick adaptation to dynamic link conditions, low processing and memory overhead, low network utilization, and determines unicast routes to destinations within the ad hoc network [10]. The protocol consists of two phases:

i) Route Discovery, and
ii) Route Maintenance.

A. Route Discovery

A node wishing to communicate with another node first seeks for a route in its routing table. If it finds one the communication starts immediately, otherwise the node initiates a route discovery phase. The route discovery process consists of a route-request message (RREQ) which is broadcasted. If a node has a valid route to the destination, it replies to the route-request with a route-reply (RREP) message. Additionally, the replying node creates a so called reverse route entry in its routing table which contains the address of the source node, the number of hops to the source, and the next hop's address, i.e. the address of the node from which the message was received. A lifetime is associated with each reverse route entry, i.e. if the route entry is not used within the lifetime it will be removed [10].

B. Route Maintenance

The second phase of the protocol is called route maintenance. It is performed by the source node and can be subdivided into: i) source node moves: source node initiates a new route discovery process, ii) destination or an intermediate node moves: a route error message (RERR) is sent to the source node. Intermediate nodes receiving a RERR update their routing table by setting the distance of the destination to infinity. If the source node receives a RERR it will initiate a new route discovery. To prevent global broadcast messages AODV introduces a local connectivity management. This is done by periodical exchanges of so called HELLO messages which are small RREP packets containing a node's address and additional information [10].

3.2 Dynamic Source Routing Protocol (DSR): The dynamic source routing (DSR) protocol is an "on- demand routing protocol" that is based on the concept of source routing. Mobile nodes are required to maintain route caches that contain the source routes of which the mobile is aware. Entries in the route cache are continually updated as new routes are discovered. The protocol consists of two major phases: Route discovery and route maintenance [11]. Each node in the network maintains a route cache in which it caches the routes it has learned. To send data to another node, if a route is found in its route cache, the sender puts this route (a list of all intermediate nodes) in the packet header and transmits it to the next hop in the path. Each intermediate node examines the header and retransmits it to the node indicated after its id in the packet route. If no route is found, the sender buffers the packet and obtains a route using the route discovery process described below [12]. When a mobile node has a packet to send to some destination, it first consults its route cache to determine whether it already has a route to the destination. If it has an unexpired route to the destination it will use this route to send packets. On the other hand, if the node does not have such a route to the destination it initiates route discovery by broadcasting a route request packet this route request contains the address to the destination along with the source nodes address and a unique identification number. A

route reply is generated when the route request reaches either the destination itself, or an intermediate node whose route cache contains an unexpired route to the destination. Route maintenance is a procedure, which maintains transmission of packets in the routing through the use of route error packets and acknowledgement. Route error generated at a node, when data link layer encounters transmission error. Acknowledgements are used to verify the correct operation of the route link [13]. DSR uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table driven approach. The intermediate nodes also utilize the route cache information efficiently to reduce the control overheads. The disadvantage of DSR is that, the route maintenance mechanism does not locally repair a broken down link. Even though the protocol performs well in static and low mobility environments, the performance degrades rapidly in with increasing mobility [14].

4. Simulation Based Analysis

In this section we have described about the tools used in paper for analysis of ad-hoc routing protocol performance i.e. about simulation tool, Simulation Setup, performance metrics used and finally the performance of simulators for protocols is represented by using graph.

4.1 Simulation Tool

A simulator is software that imitates selected parts of the behaviour of the real world and is normally used as a tool for research and development [15]. Network simulators are used by people from different areas such as academic researchers, industrial developers, and Quality Assurance (QA) to design, simulate, verify, and analyze the performance of different networks protocols. With their help, one can design different network topologies using various types of nodes such as end-hosts, hubs, network bridges, routers, optical link-layer devices, and mobile units [16, 17].

Type	Network simulators name
Commercial	OPNET, QualNet
Open source	NS2, NS3, OMNeT++, SSFNet, J-Sim

Table 1: classification of Network Simulators

4.2 Overview of NS2 and OPNET

NS2 (Network Simulator-2):- Network Simulator [18, 19] (specially higher versions, like NS-3) has been used to evaluate MNAETs but the accuracy of results with lower versions (NS-2) are questionable since the MAC protocols, packet formats, and energy models are very different from those of typical ad-hoc network platforms. The original NS is a discrete event simulator targeted at networking research [20]. NS2 is the second version of NS (Network Simulator). NS is originally based on REAL network simulator [21].

OPNET Modeler 14.5:- OPNET is the registered commercial trademark and the name of product presented by OPNET Technologies incorporation. It is one of the most famous and popular commercial network simulators by the end of 2008. Because of it has been used for a long time in the industry, it become mature and has occupied a big market share [22].

4.3 Simulation Setup

The performance analysis is done on Fedora 17 Operating System. Ns–allinone-2.35 was installed on the platform. And OPNET Modeler 14.5 was installed on the platform Windows XP.

Seed	**1.0**
Simulation tool used	**NS-2.35, OPNET Modeler 14.5**
Simulation Time	**100 Sec**
Simulation Area	**1000*1000**
Rate	**5.5 mbps**
Traffic Type	**TCP**
Number Of Nodes	**100**
Routing Protocol	**DSR,AODV**
Mobility	**Random Way Point**

Table 2: simulation setup

4.4 Performance Metrics Used

The following metrics are used in this paper for the analysis of AODV and DSR routing protocols:

i) Packet Delivery Ratio
ii) Average End to End Delay
iii) Throughout
iv) Packet dropped (loss) in bits

1. Packet Delivery Ratio (PDR): This is the ratio of total number of packets successfully received by the destination nodes to the number of packets sent by the source nodes throughout the simulation [23].

$$\textbf{PDR} = \frac{\textbf{Number of received packets}}{\textbf{Number of sent packets}}$$

2. Average End to End Delay: Average end-to-end delay signifies how long it will take a packet to travel from source to destination node. It includes delays due to route discovery, queuing, propagation delay and transfer time [24]. This metric is useful in understanding the delay caused while discovering path from source to destination [25].

$$\textbf{Avg. E-to-E Delay} = \frac{\textbf{Time received} - \textbf{Time sent}}{\textbf{Total data packets recieved}}$$

3. Throughout: Throughput is the average rate of successful data packets received at destination. It is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second [26].

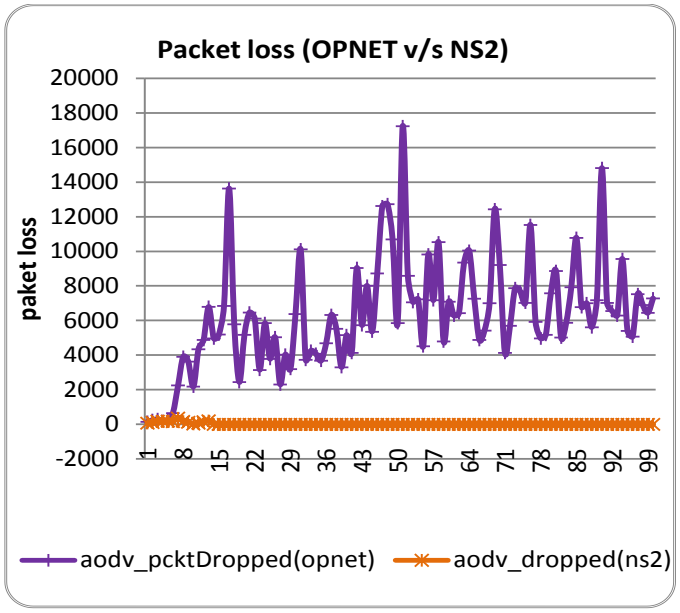
$$\textbf{Throughput} = \frac{\textbf{No.of delivered packet} * \textbf{packet size} * \textbf{8}}{\textbf{Total duration of simulation}}$$

4. Packet dropped (loss):
= Total Sent Packets – Total Received Packet

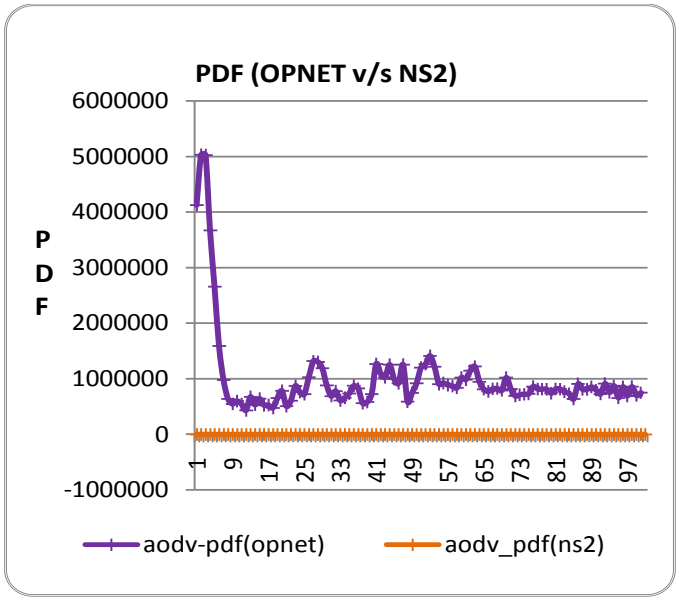
4.5 Simulation result Analysis

Analysis is based on comparison of NS2 and OPNET performance. Below comparative graphs are presented for AODV and DSR with individual parameters i.e., PDF, throughput, Average End-to-End Delay, Packet loss. Graphs are plotted for NS2 and OPNET comparison. Graph is easier way to analyse and compare any data or properties. So we are using graph to show comparison. It is easily understandable for unknown person also.

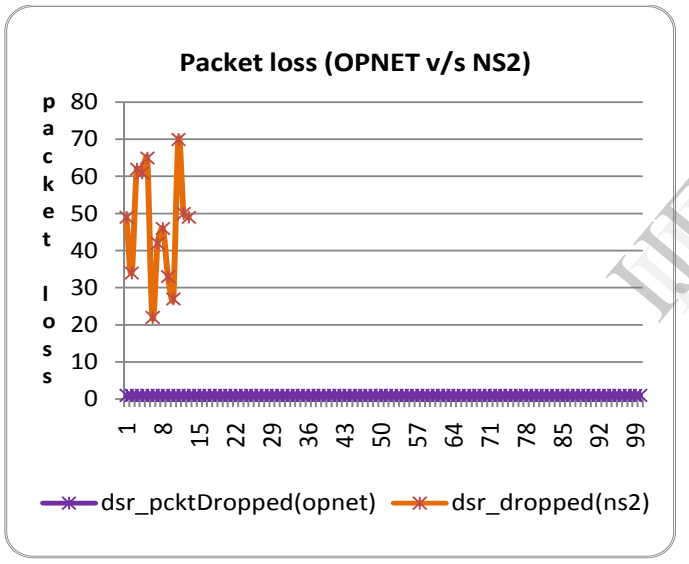
1. Packet loss: Graph 1 and 2 shows packets loss in AODV and DSR routing protocol. In AODV protocol, packet loss for NS2 is negligible as compared to OPNET. But in second graph, it is opposite, for DSR packet loss in OPNET is constant. But in NS2, it is frequently increased. In AODV, packet dropped graph is very high,, and frequent for OPNET, so there is a large number of data packets are dropped during transmission, therefore it not transmitted accurate data.



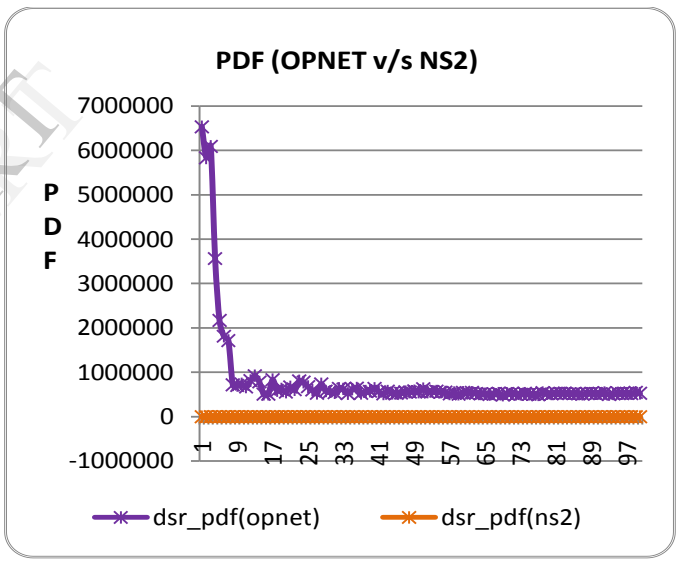
Graph 1



Graph 3



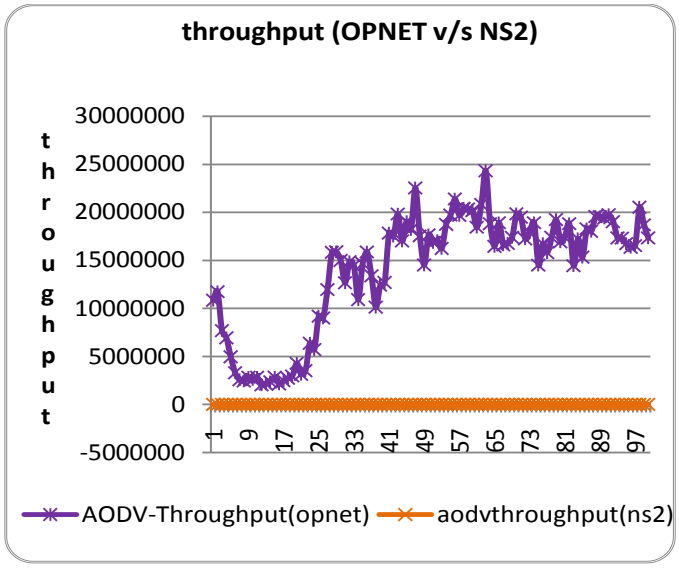
Graph 2



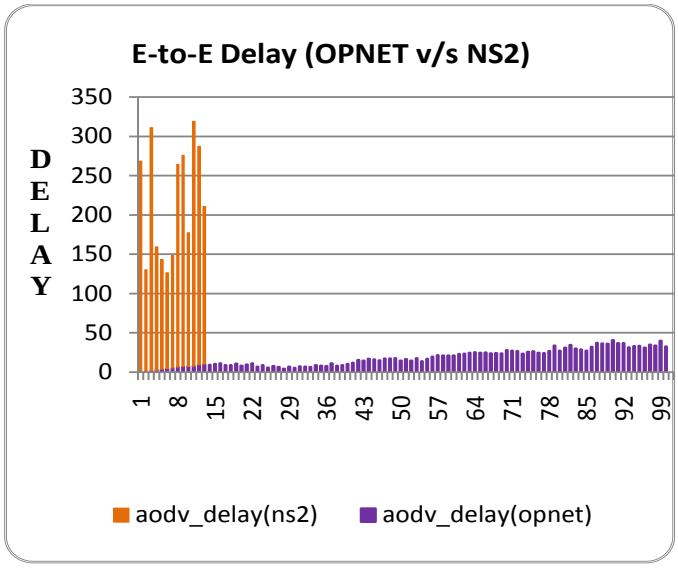
Graph 4

2. PDR: Graph 3 and 4 shows PDF variation between NS2 and OPNET. In NS2, for both cases AODV and DSR, PDF is very down and constant. And in OPNET, PDF graph is not good, but much better than NS2. For AODV protocol, PDF is much better than DSR. This graph is plotted for 100 nodes. Observed from my previous paper [27], if number of nodes is less, than DSR gives good result for PDF with NS2. Its also possible by increasing the pause time.

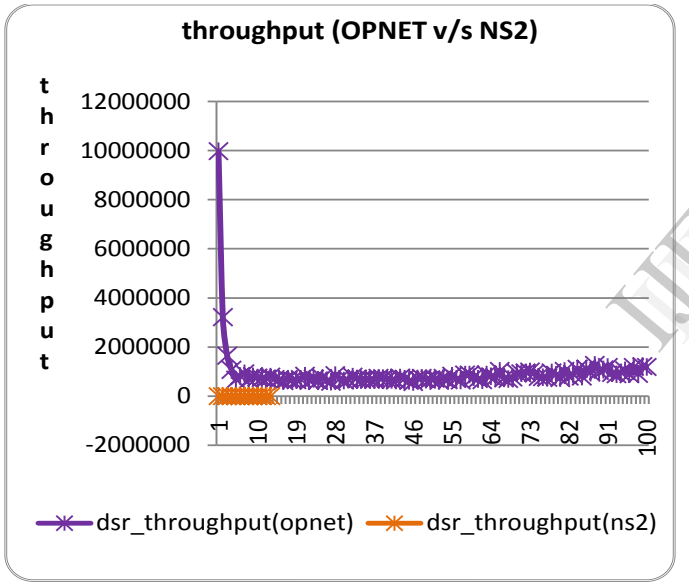
3. Throughput: Graph 5 and 6 shows throughput for AODV and DSR. Value obtained for throughput is good in OPNET simulator. AODV protocol is gives good throughput in OPNET simulator. But NS2 performs very worst. In DSR protocol, throughput goes down for OPNET, but as compare to NS2 it is well performed. AODV is good for throughput rather than DSR.



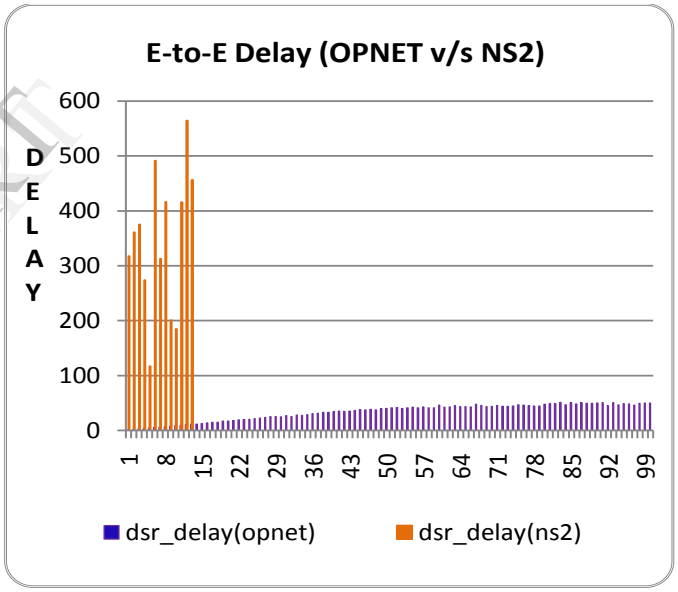
Graph 5



Graph 7



Graph 6



Graph 8

4. Avg. E-to-E Delay: Graph 7 and 8 shows E-to-E delay for AODV and DSR. In both cases OPNET performs better than NS2. In OPNET, delay is very low, and its variation is not so much frequent. But in NS2, delay is very high, and it vary high to low and again low to high with time. E-to-E Delay should be low for a good data transmission, but in NS2, delay is in high pick point, which not provides accuracy in data transmission.

From above graphs, and analysis of these graphs, we can say that OPNET is better than NS2. OPNET provides Graphical User Interface, which easier to use. And it provides many other fields for research. One drawback of OPNET is that, before every simulation, it updates all the file and features, so it takes more time for simulation.

Comparison table of NS2 and OPNET:

According to features

NS2	OPNET
Open source (easily available)	Commercial level simulator
Kernal code is open source.	Opnet modeller kernel code is not open source.
Command based	GUI and drag and drop function based
Supported by both platform : Windows (CygWin) and UNIX	Supported by only Windows version
No extra requirement are needed for NS2	Visual studio and C++ library are must for OPNET

Table 3

According to parameters used

	NS2	OPNET
E-to-E Delay	Worst	Very Good
PDF	Constant (bad)	Frequently change
Packet Loss	Less in AODV, but very much for DSR	More data loss in AODV, but in DSR negligible
Throughput	Worst	good

5. Conclusion

In this work, a comparative study between two common network simulation tools, namely, ns-2 and OPNET Modeler, has been carried out, involving several parameter metrics of MANETs routing protocol for AODV and DSR. Some important differences between the two simulators have been reported. After describing the scenarios, the obtained results using OPNET in scenario 2 are shown, comparing them with the scenario 1 results using ns-2.The conclusions based on the simulation results for the different MANET scenarios are that the trends of all the metrics in both simulators were rather consistent, although in certain experiments absolute values are quite different. From the results obtained we can conclude that OPNET is good for MANET routing protocol scenarios, it is user friendly, and easy to use, because of no need to remember the commands. But also NS2 is easily available tool.

In future, this experiment can be done for other routing protocols. Today extended version of NS2, named NS3 is also available, which supports GUI functionality. So that in future, OPNET can be compared with NS3. This work is done with few parameters; this can be extended for more parameters. And also the comparison can be made for other simulators.

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