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Performance Evaluation of AODV, DSR & TORA in Mobile Ad hoc Networks (MANETs) Using OPNET

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Abstract: ***The area of Mobile Ad hoc Networks (MANETs) has picked up an imperative part of the interest of analysts and turn out to be exceptionally famous in most recent couple of years. MANETs can work without fixed infra structure and a survive fast changes in the network topology. They can be studied formally as graphs in which the set of edges differ in time. The fundamental strategy for evaluating the performance of MANETs is simulation analysis using OPNET modeler. This paper is subjected to the on-demand routing protocols AODV, DSR and TORA with identical loads and environment conditions also evaluates their relative performance concerning the performance metrics: average delay, load, throughput, Data dropped and Retransmission. From the detailed simulation results and investigation, appropriate routing protocol can be selection for a specified network and goal.***

Keywords: MANET, AODV, DSR, TORA

This study gives a relative study through simulation of three routing protocols (DSR, AODV and TORA) for MANET networks utilizing OPNET modeler. The primary goal of this study is to make a decision guide of routing protocol for a given network situation, based on the relative execution of the protocol. The study quickly portrays the routing protocols; the simulation apparatus utilized for this work, simulation environment, and brief examination on simulation mode, simulation results and conclusion comments

1. Introduction

The historical backdrop of wireless networks began in the 1970s and the interest has been becoming from that point onward. At present, this sharing of data is troublesome, as the clients need to perform managerial undertakings and set up static, bi-directional connections between the computers. This persuades the development of temporary networks without any wires, no communication infrastructure and no regulatory mediation required. Such interconnection between mobile computers is called an Ad hoc Network. Ad hoc Networks are rising as the next generation of networks and defined as an collection of mobile nodes framing a brief (spontaneous) network without the guide of any incorporated organization or standard support services. In Latin, specially appointed actually signifies "for this, “further signifying "for this reason just" and along these lines normally temporary [1 An ad hoc network is generally considered as a network with nodes that are relatively mobile compared with a wired network. Subsequently the topology of the network is a great deal more dynamic and the changes are regularly erratic restrict to the Internet which is a wired network. This reality makes many challenging research issues, since the destinations of how routing should take place is often unclear because of the different resources like bandwidth, battery power and requests like in activity.

2. Routing Protocols

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

- Proactive or table-driven routing protocols
- Reactive or on-demand routing protocols.

3. Overview of AODV, DSR and TORA

Ad-hoc On Demand Distance Vector (AODV)
AODV (Perkins et al., 2003; Chaudhry et al., 2005) is an reactive (On-demand routing protocol) with small Delay. Since it is an “On-demand” routing protocol, the routes are established only when needed to reduce traffic load. AODV supports the Uncast, Broadcast and Multicast scheme. The Count-To-Infinity and loop problem is solved. With sequence numbers and the registration of the costs. In AODV every hop has the constant cost of one. The routes age very quickly in order to accommodate the movement of the mobile nodes. Link breakages can locally be repaired very efficiently. AODV is a modification of the DSDV algorithm. When a source node desires to establish communication session, it initiates a path discovery process to locate the other node. The main advantage of AODV protocol is that routes are established on demand and destination sequence numbers are used to find the latest route to the destination. The connection setup delay is less. The HELLO messages supporting the routes maintenance are range-limited, so they do not cause unnecessary overhead in the network.

Dynamic Source Routing (DSR):
The Dynamic Source Routing protocol (DSR) (Johnson et al., 1999) is a basic and effective routing protocol planned particularly for use in multi-hop wireless Ad- networks of mobile nodes. DSR permits the network to be totally self-arranging and self-designing, without the requirement for any current network infrastructure or administration. The protocol is made out of the two fundamental instruments of

"Route Discovery" and "Route Maintenance ", which cooperate to permit nodes to find and maintain routes to discretionary destinations in the ad hoc network. However, this protocol has a number of advantages over routing protocols, for example, AODV, LMR and TORA and in little to decently size network (maybe up to a couple of hundred nodes), this protocol may perform better An advantage of DSR is that nodes can store various routes in their route cache, which implies that the source node can check its route cache for a valid route before route discovery, if a valid route is found there is no requirement for route discovery. This is exceptionally useful in network with low mobility. Since they routes stored in the route cache will be valid longer. Another advantage of DSR is that it doesn't require any periodic beaconing (or hello message trades), along these lines nodes can enter rest node to ration their energy. This also saves an extensive measure of bandwidth in the network

Temporary Ordered Routing Algorithm (TORA)
The Temporally Ordered Routing Algorithm (TORA is a very versatile, proficient and adaptable appropriated routing calculation in light of the idea of link inversion [3]. TORA is proposed for very dynamic mobile, multi-bounce wireless network. It is a source-started on-demand routing protocol. It finds various routes from a source node to a destination node. The primary component of TORA is that the control messages are limited to a little arrangement of nodes close to the event of a topological change. To accomplish this,

The nodes keep up routing data about adjoining nodes. The protocol has three fundamental capacities: Route creation, Route *maintenance* and Route *erasure*. TORA can experience the ill effects of unbounded most pessimistic scenario merging time for extremely unpleasant situations. TORA has an exceptional component of maintaining multiple routes to the destination so that topological changes don't require any response by any means. The protocol responds just when all routes to the destination are Lost. In case of network segments the protocol can identify the parcel and eradicate every single invalid route.

4. Comparative Study of Ad Hoc Routing Protocols

Metrics for Performance Comparison
MANET has number of qualitative and quantitative metrics that can be used to compare ad hoc routing protocols the table. I illustrate the comparison of AODV, DSR and TORA routing protocols. This paper has been considered the following metrics to evaluate the performance of ad hoc network routing protocols.

1) **Delay:** This metric can be measured in different ways; firstly the duration a packet spends at the queue during transmission. It additionally decides the support time and spread time delay. Delay can be categorized as the network efficiency while using maximum resources by a network protocol.
2) **Load:** This metric is measured the total load bit/sec submitted to wireless LAN, when there is more traffic entering into the network
3) **Throughput:** This metric determines the average rate of packets arrived over a transmission channel and the unit of measured is a bit per second (bits/second). It also measures the proficiency and adequacy of the routing protocol performance and determines the network performance from one node to destination.
4) **Data dropped**: is expressed as a ratio of the number of packets lost to the total number of packets transmitted. Data dropped results when packets sent are not received at the last destination.
5) **Retransmission:** This metric represents the resending of packets which have been damaged or lost.

5. OPNET Modeler

OPNET Modeler is commercial network simulation environment for network modeling and simulation. It allows the users to design and study communication networks, devices, protocols, and applications with flexibility and scalability. It simulates the network graphically and gives the graphical structure of actual networks and network components. The users can design the network model visually. The modeler uses object-oriented modeling approach. The nodes and protocols are modeled as classes with inheritance and specialization. It provides a variety of toolboxes to design, simulate and analyze a network topology, routing protocols on the basis of various network parameters. MANET toolbox has been used in this work to simulate the network. Components used for designing of the network are MANET Station (mobile), application configuration which decides the type of application running in the network, profile configuration for configuring the type of profile on the network. In profile configuration start time and stop time of the application can be set and pause time between the nodes is set. Mobility configuration will decide the mobility model of every node which is selected as random waypoint for this simulation. Attributes of workstation will set the routing protocol used for the simulation.

6. Methodology

Simulation Environment

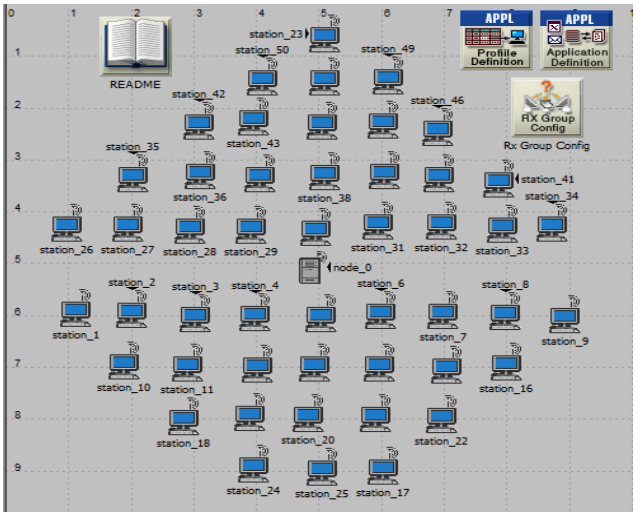

Figure 1: MANET Scenario

This scenario have been modeled and assessed utilizing OPNET modeler 14.5 [4][5] Figure 1. Shows a sample network made with50 nodes.

Figure 1 delineates a network with 50 mobile nodes whose conduct must be analyzed when nodes move in the network concerning time to decide the affecting elements of every protocol.. In order to assess the execution of a non specific scenario in ad-hoc networking, when analyzing mobile networks, displaying the development of the arrangement of nodes forming MANET is key. Irregular waypoint model of versatility has been examined. The Random Waypoint model has been chosen to be utilized in all simulations presented in this archive. Utilizing Random Waypoint model, nodes go moving until they land at an irregular destination ascertained by the algorithm. Once there, they get still for a timeframe, called the delay interim. Once passed the interruption interim, another development is figured by the algorithm, with an irregular heading and speed.

Simulation Model

Main characteristics of the scenarios maintained are depicted in the Table 1.

Table 1: Simulation Parameters

Statistic	*Value*
Routing protocol	AODV, DSR, TORA
Scenario Size	10kmx10km
Nodes	50
Node position	Random
802.11 data rate	11mbps
Simulation Time	1 h

7. Simulation Results

The simulation results are shown in the following section in the form of line graphs. Graphs show comparison between the AODV, DSR and TORA protocols by varying different numbers of sources on the basis of the above-mentioned metrics

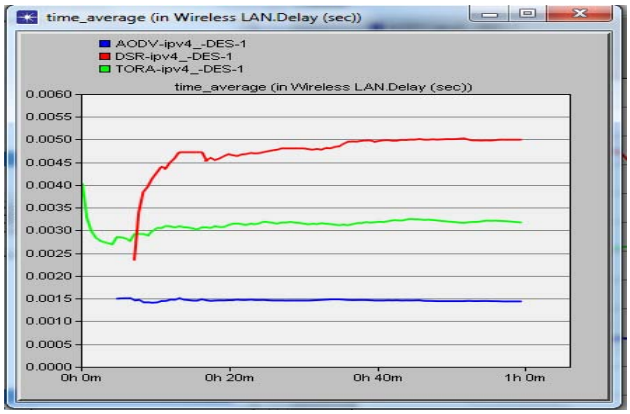

Figure 2: Delay (sec)

Figure (2) show **AODV** has a minimum value compared with the TORA and DSR. But DSR is maximum value.

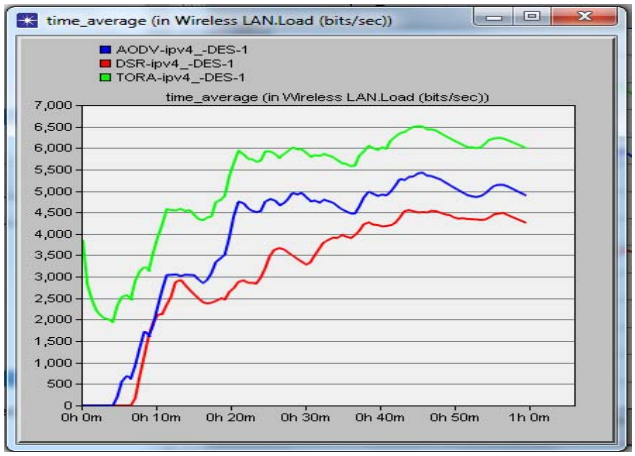

Figure 3: Load (bits/Sec)

Figure (3) show The Network load of TORA is higher value compared with AODV and DSR.

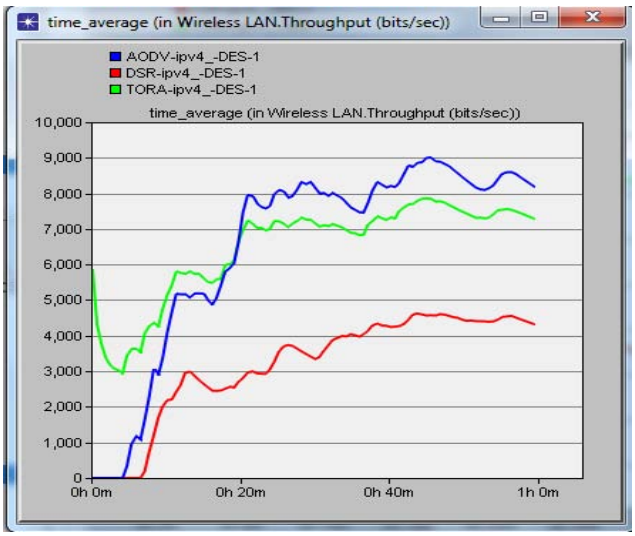

Figure 4: Throughput (bits/sec)

Figure (4) show The AODV perform well and higher Value throughput than TORA and DSR.

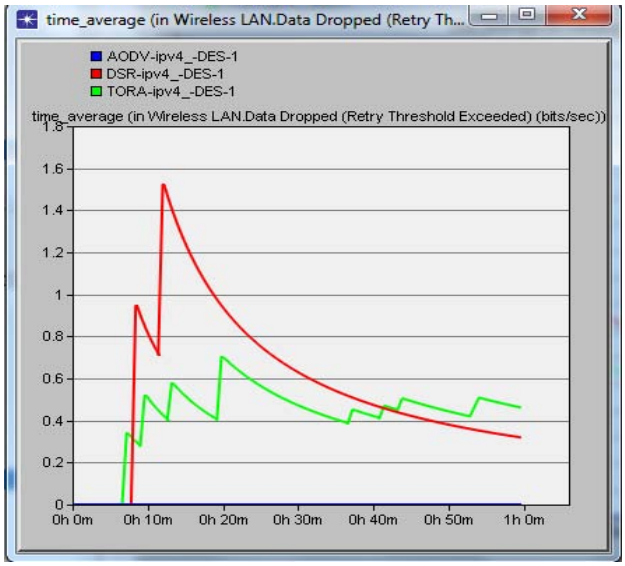

Figure 5: Data Dropped

Figure (5) show Data dropped of TORA is maximum followed by AODV and DSR.AODV is not showing any data packet dropped during simulation extent.

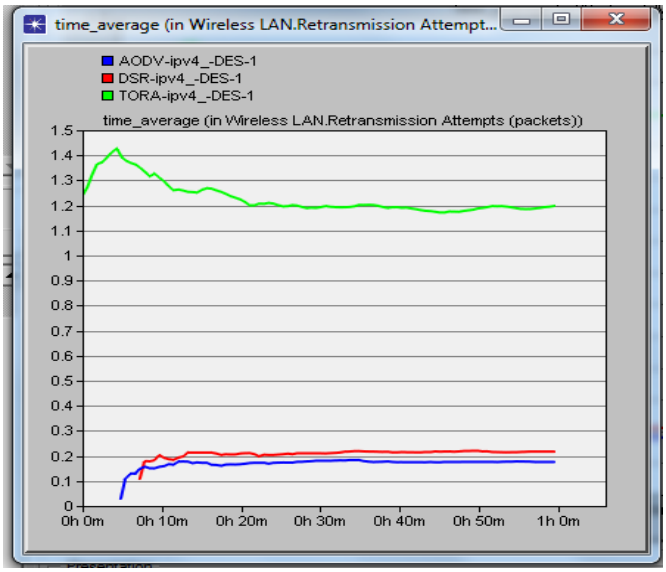

Figure 6: Retransmission

Figure (6) show AODV has a minimum value of the resending of packets or retransmission compared with DSR and TORA.

8. Conclusion

The simulation study of our work consisted of three routing protocols AODV, DSR and TORA deployed over MANET analyzing their behavior with respect to Delay, load throughput, Data dropped and Retransmission. The Motive of doing this simulation was to check the performance of these routing protocols in MANET in the previously mentioned parameter. The selection of efficient and reliable protocol is a critical issue. From the above analysis of routing protocols, the AODV outperforms the TORA protocol in terms of Delay in 50 mobile nodes. In next scenario mobile nodes again the AODV perform well than TORA and DSR in throughput and minimum value Retransmission packets. By comparing the results in the entire figures {2} {4} {5} and {6}, it can be seen that AODV perform well than TORA and DSR.

The study of these routing protocols shows that the AODV performs better than TORA and DSR when the numbers of nodes are increased in a network according to our the nodes (more than 50 nodes) in simulation results but it is not necessary that AODV perform always better in all the networks, its performance may differ by fluctuating the network. Toward the end we went to the point from our simulation and analytical study that the performance of routing protocols differ with network and determination of accurate routing protocols according to the network, at last impact the efficiency of that network in radiant way.

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