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Simulation Based Comparative Performance Analysis of Routing Protocol over Adhoc Networks Using *AODV, TORA and LEACH*

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ABSTRACT*:* Mobile Ad-Hoc Networks (MANETs) are autonomous and decentralized wireless systems. Mobile Ad hoc Network is a collection of mobile nodes in which the wireless links are frequently broken down due to mobility and dynamic infrastructure. Routing is a significant issue and challenge in ad hoc networks. Many Routing protocols have been proposed so far to improve the routing performance and reliability. There are many issues, problems in the Mobile Ad hoc Network; likewise there is Mobility issue when devices are moved independently. The aim of this research is to analyze the protocols on five parameters packet delivery fraction, average end to end delay, packet loss, remaining node energy and Routing overhead in terms of packet . AODV, TORA and LEACH protocols are studied in this research . LEACH is one of the most interested techniques that offer an efficient way to minimize the power consumption in sensor networks. These simulations are carried out using the NS-2 network simulator. The result presented in this work illustrates the importance in evaluating and implementing routing protocols in MANET. By using network simulator NS2, we setup and evaluate the performance of AODV, TORA and LEACH protocols with respect to the above mentioned parameters.

KEYWORDS: MANET, AODV, TORA, LEACH, NS-2, SIMULATIONS

I. INTRODUCTION

Mobile ad hoc networks (MANETs) are a heterogeneous mix of different wireless and mobile devices, ranging from little hand-held devices to laptops that are dynamically and arbitrarily located in such a manner that the interconnections between nodes are capable of changing on a continual basis. An ad hoc network is a group of wireless mobile computers (or nodes) in which nodes cooperate by forwarding packets for each other to allow a node to communicate beyond its direct wireless transmission range. Ad hoc networks require no centralized administration or fixed network infrastructure such as base stations or access points and can be quickly and inexpensively set up as needed. In Ad Hoc Networks the individual mobile hosts (nodes) act at the same time as both the router and the host. In a MANET, nodes within each other's wireless transmission ranges can communicate directly. However when a node wants to send a message to another node, which is situated outside its communication range, it has to rely on some other nodes to relay its messages. Thus, a multi-hop scenario occurs, where several intermediate hosts relay the packets sent by the source host before they reach the destination host. The network topology may change with time as the nodes move or adjust their transmission and reception parameters. Routing protocols are used to find routes for transmission of packets. Routing is the most fundamental research issue in MANETs. The merit of a routing protocol can be analysed through metrics-both qualitative and quantitative. Desirable qualitative properties of a routing protocol for MANETs are Distributed operation, Loop-freedom, Demand-based operation, Security, Sleep period operation and unidirectional link support. Some quantitative metrics that can be used to assess the performance of any routing protocol are End-to end delay, throughput, PDF, NRL and Route Acquisition Time etc. Routing protocols for ad hoc networks must deal with limitations such as high error rates, scalability, security, quality of service, energy efficiency, multicast, aggregation and node cooperation etc.

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The Communication in Mobile Ad-Hoc Network (MANET) is to take place by using multi-hop paths. Nodes in the MANET share the wireless medium and the topology of the network changes erratically and dynamically. In MANET, breaking of communication link is very frequent, as nodes are free to move to anywhere. The density of nodes and the number of nodes are dependent on the applications in which we are using MANET. An ad hoc network is usually thought of as a network with nodes that are relatively mobile compared to a wired network. Hence the topology of the network is much more dynamic and the changes are often unpredictable oppose to the Internet which is a wired network. This fact creates many challenging research issues.

II. MOBILE ADHOC NETWORK (MANET)

MANET consists of set of wireless mobile nodes connected together to form temporary network in which the nodes are communicating with each other without centralized control. Mobile Ad-Hoc Networks are autonomous and decentralized wireless systems. In MANETs mobile nodes are free to move in and out of the network. Nodes are the systems or devices i.e. mobile phone, laptop, personal digital assistance, wireless devices and personal computer that are participating in the network and are mobile. When a node wants to communicate with another node, the destination node must lies within the radio range of the source node that wants to initiate the communication. The intermediate nodes within the network aid in routing the packets for the source node to the destination node.

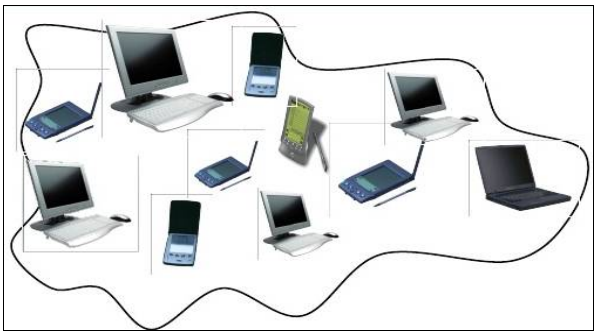

Fig 1.1 MANET Network

These networks are fully self organized, having the capability to work anywhere without any infrastructure. In MANETs each device need to forward traffic that is not related to its own use and therefore each device work as a router. These nodes can act as host/router or both at the same time. They can form arbitrary topologies depending on their connectivity with each other in the network. These nodes have the ability to configure themselves and because of their self configuration ability, they can be deployed urgently without the need of any infrastructure and without any geographical restrictions. Each user has the opportunity of moving freely while communicating with others.

2.1 MANETs have several salient characteristics:

1) Dynamic topologies
2) Bandwidth constrained, variable capacity links
3) Energy-constrained operation
4) Limited physical security.
5) Adhoc based Network
6) Autonomous System
7) Multi-hop Routing

III. PROPOSED WORK

Our proposed work is based upon the efficiency and optimization of protocols discussed here:

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i. AODV: It is the base protocol. It tries to minimize required no. of broadcast. It is the improved version of DSDV. It creates routes on a on demand basis as opposed to maintain a complete list of routes for each destination. It has path discovery process, maintaining routes. It leads to frequent system wide broadcasts. Its size is strongly limited. AODV provides both a route table for uni-cast routes and a multicast route table for multicast routes. It combines uni-cast, multi-cast, and multicast communications but it uses symmetric links between neighbouring nodes.

ii. LEACH: A node in network is no longer useful when its battery dies so we use LEACH. It space out the lifespan of the nodes allowing it to do the only minimum work it needs to transmit data. It has 2 phases: setup phase, where cluster head are chosen and steady phase, in which CH is maintained when data is transmitted between nodes. Goal of LEACH is to increase the life of network. It is clustering based routing protocol minimizes global energy usage by distributing load to all nodes at different point in time.

iii. TORA: This is adaptive and scalable routing algorithm based on the concept of link reversal. It finds multiple routes from source to destination in a highly dynamic mobile networking environment. The concept of TORA is that control messages are localized to a small set of nodes.

VI. IMPLEMENTATION

4.1 Simulation Tool

The tool used for simulation is NS-2 which is highly preferred by research communities. The network simulator version 2 (NS-2) is a package of tools that simulates behaviour of networks. It is a discrete event network simulator developed at UC Berkeley that focuses on the simulation of IP networks on the packet level. It can simulate both wired and wireless network. Wireless network research in the last years is often based on simulation. Ns-2 is a widely used wireless network simulation tool for this purpose.

4.2 Simulation Parameter

The following simulation parameters are used in this paper to analyse the performance of routing protocols.

PARAMETER	VALUES
Packet Delivery Fraction	AODV- 120 (Max), TORA - 100 (Max), LEACH – 90 (Max)
Avg. End to End Delay	AODV- 210 (Max), TORA - 150 (Max), LEACH – 175 (Max)
Packet Loss	AODV- 1200 (Max), TORA - 900 (Max), LEACH – 600 (Max)
Energy Loss	AODV- 85 (Max), TORA - 75 (Max), LEACH – 70 (Max)
Routing Overhead	AODV- 35 (Max), TORA - 60 (Max), LEACH – 45 (Max)
Number of nodes	350
Simulation time	30 Sec
Protocols	LEACH, TORA, AODV

Table 1.1 Table of Simulation Parameter's Values

V. RESULTS

The simulation results are shown in the following section in the form of graphs and charts. In this, sections the performance of the parameters are analysed and compares it with an underlying ad hoc routing protocol. An attempt

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has been made to evaluate the performance of three routing protocol AODV, LEACH and TORA according to the simulation results. NS2 simulator generated a AODV.tcl, LEACH.tcl, TORA.tcl file which contains all the statistics regarding number of packet delivery fraction, average end-to-end delay (in seconds), packet loss, energy loss and routing overhead in terms of packets.

i. Packet delivery fraction

As we know packet delivery fraction shows the ratio of number of packets delivered to destination generated by constant bit source. So as per the characteristics we can easily see in the graph that AODV when works with limited number of nodes, delivers at very good rate of PDF but it decreases as we increase the number of nodes. TORA gives better performance for Packet Delivery Fraction because it is very highly adaptive and TORA is based on the concept of link reversal and selection process of a route includes three steps route creation, route maintenance and route ensure .So TORA provides loop free paths at all instants and multiple routes so that if one path is not available, other is readily available. It establishes routes quickly so that they may be used before the topology changes. But when we used leach protocol the ratio of PDF goes down as number of nodes increases. So we can conclude by our analysis that AODV and TORA gives better performance than LEACH.

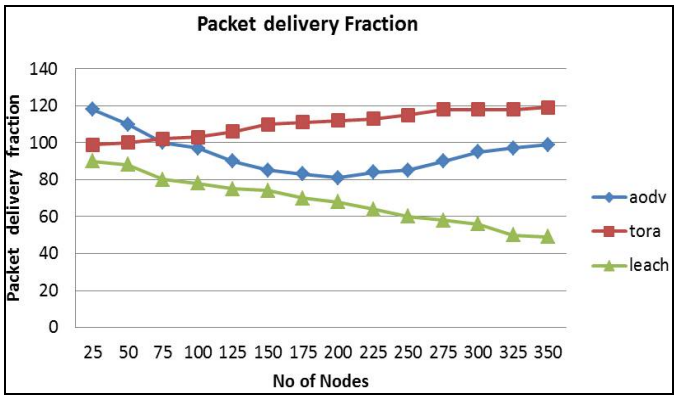

Fig. 1.3 Packet Delivery Fraction Comparisons

ii. Average End-To-End Delay

Average end to end delay includes all the possible delays caused by buffering during route discovery, queuing at the interface queue, retransmission delay at the MAC, and propagation and transfer times. We analyzed that in starting LEACH gives high number of delay because of complex routing selection procedure but once route selection is done, it gives lesser no of delays. TORA gives less no of delays because in this if one link of connection fails, another one is ready to send data so it's always be consistent in sending data without unnecessary delay But AODV gives higher no of delay because at the time of routing each time it sends request and reply messages and it creates unnecessary delay .

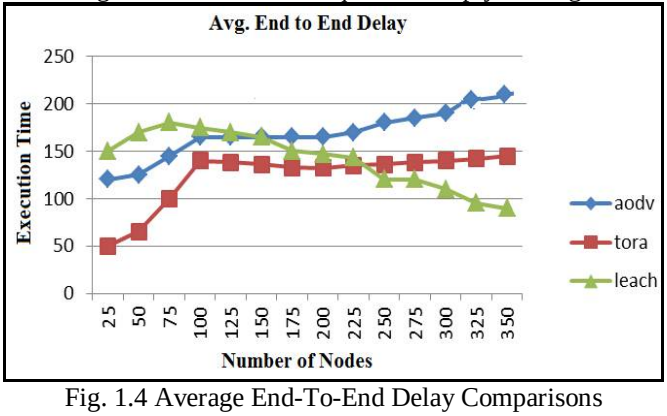

Fig. 1.4 Average End-To-End Delay Comparisons

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iii. Packet Loss

Packet loss is the concept which shows the no of packets which has been dropped because of any reason. A packet drops in two cases: buffer becomes full when packet needs to be buffered and the time that the packet has been buffered exceeds the limit. As we can see in the experimental scenario that AODV and TORA gives higher number of packet loss as compared to LEACH because of delay.

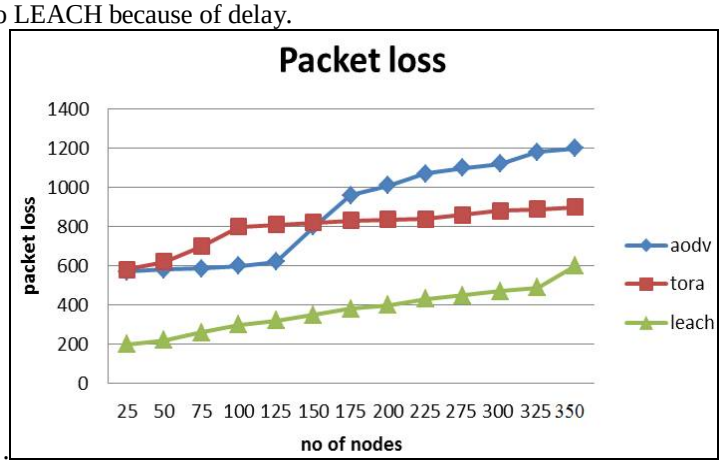

Fig. 1.5 Packet Loss Comparisons

iv. Routing Overhead

The routing overhead is measured as the total number of routing packets transmitted. As per calculation,

Routing overheads = (Total number of bytes of control packet transmitted by routing protocol) / Total Bytes transmitted.

AODV has lower routing overhead as compared to both of the protocols because AODV only sends request and replay messages during route selection process. AODV gives less routing overhead than routing protocols which need to have all the information from source to destination node and AODV is also relatively quick to the topological changes in the network, and maintenance of route is also quite simple then other protocols. Leach and TORA gives higher routing overhead because of its route selection procedure.

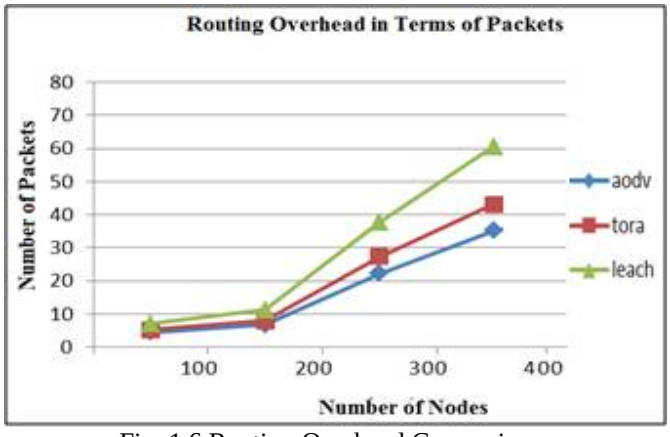

Fig. 1.6 Routing Overhead Comparisons

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v. Remaining Node Energy

With the help of this study we can see performance of all three protocols in terms of remaining node energy. Where we analyzed protocol AODV performed good at starting but when no of nodes get increased it does not perform consistently. Protocol TORA performs better than AODV rather it is also not consistent but when we analysed protocol Leach we saw that it perform good consistently because LEACH itself made for saving energy of node and its main aim is to optimized the energy requirement during path selection and establishment of route .

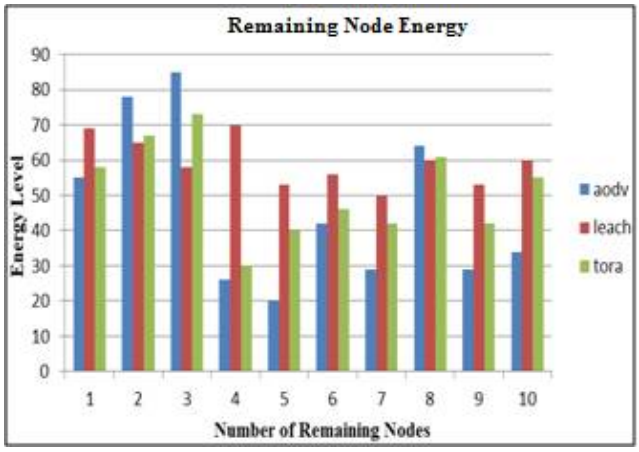

Fig. remaining node energy Comparisons

VI. COMPARISONS

The performances of routing protocols were evaluated on the basis of five performance metrics:
i. Packet Delivery Fraction (PDF)
ii. Average End-to-End Delay
iii. Packet Loss.
iv. Energy Loss
v. Routing Overhead
We compare the above parameters on the basis of simulation results on the protocols AODV, LEACH and TORA. The comparison of performance is given here in the table.

PERFORMANCE PARAMETER	**SIMULATION RESULTS**
Packet Delivery Fraction	AODV- 85 % (Best Performance), TORA – 71 % , LEACH – 64 %
Avg. End to End Delay	AODV- 84 %, TORA – 60 %, LEACH – 70 % (Best Performance)
Packet Loss	AODV- 85 %, TORA – 64 % , LEACH – 42 % (Best Performance)
Remaining Node's Energy	AODV- 94 % , TORA – 83 %, LEACH – 77 % (Best Performance)
Routing Overhead	AODV- 43 % (Best Performance), TORA – 75 %, LEACH – 56 %

Table 1.2 Comparison of performance of Protocols

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VII. CONCLUSIONS

In the research, we have analysed and compared three popular routing protocols in the presence of different scenario in network. The performance of AODV, LEACH and TORA protocols are analysed on the basis of five parameters. The packet delivery ratio, average end to end delay, packet loss, remaining node's energy and routing overhead are parameters for performance. In our research, after analysis in different state of network, we conclude that AODV is best for Packet Delivery Fraction. The LEACH gives better results among three protocols for Avg. End to End Delay, Remaining Node's Energy and Packet loss.

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