

Performance Evaluation of Routing Protocols for Manet using NS2

Reena
M.Tech (CSE) Scholar
LNCT, Bhopal, India

Rekha Pandit
Asst. Professor CSE Dept.
LNCT, Bhopal, India

Vineet Richariya
HOD, CSE Dept.
LNCT, Bhopal, India

ABSTRACT

Mobile Ad hoc Network (MANET) is a group of wireless node, which rapidly moves, changes and forms a network without need of centralized controlling entity [1]. The entire nodes in MANET intercommunicate with other node which stays in its relative frequency range. Each node in MANET works as router, so each node forward packet to neighbor node until packet it reaches to destination. There are many routing protocols as DSR, AODV, DSDV, TORA, and OLSR etc each having its own working mechanism. In this paper we are presenting performance comparability with DSR, TORA and LEACH protocols based on metrics such as Throughput, Average Jitter, End to End Delivery, and Packet Delivery Ratio by using NS2 Simulator.

Keywords: MANET, DSR, TORA, LEACH, Throughput, Packet Delivery Ratio, End to End Delay, Average jitter

1. INTRODUCTION

MANET is a group of wireless mobile node that arbitrarily setup the network when there is no fixed infrastructure of network like topology where conceptually there is a fixed infrastructure, in which system /node are attached. One thing makes the MANET very popular is that each node is capable to work as router to seek the path for sending the packet or data.

In Latin, adhoc means “for this purpose only” its nice description why we need the adhoc network .MANET can be establishes anywhere without any base station or physical infrastructure. When any node comes into or goes out the network, conceptually MANET changes dynamically.

2. RELATED WORK

There are various types of comparison has been performed with routing protocols. Most of researcher shown their works to increase the performance of network bandwidth, Throughput, less packet loss, less energy consumption and over different types of parameters. Each protocol in network has its own pros and cons with different scenario.

In [1], author gave a comparison of routing protocol in MANET, where DSDV, AODV, DSR are compared using NS2 simulator. Author shown that DSR performance is better in compression of AODV and DSDV due to a smaller amount of routing overhead when node have high mobility, counting the metrics throughput, Average End to End Delay and Packet Delivery Ratio.

In [2], comparison of AODV, TORA, LEACH protocols has been performed with the metrics-Average End to End Delay, Packet Delivery fraction, packet loss. LEACH is better for Average End to End Delay, less packet loss but not in case of Packet delivery ratio.

In [3],comparison of DSDV, AODV, DSR protocols has been performed using NS2.AODV perform well when area is large, nodes are dense and movement of nodes are higher.DSR is good for the condition when there is balanced traffic and mobility and When no. of packet and movement of nodes is less then DSDV will be preferable.

In [7] comparison is performed on DSR,FSR, and ZRP in MANET with the metrics End To End Delay, packet Delivery ratio, throughput, Average Jitter. From the study of simulation is clear that performance of DSR is better than FSR,ZRP in case of Packet delivery ratio and Throughput but is performs worst in terms of average jitter.ZRP has less Average Jitter, but poor throughput.FSR has lowest End To End Delay but higher Average jitter than ZRP.

In [12], there is comparison of routing protocol AODV, DSR, TORA in MANET by using OPNET Modeler. In this paper author gave shown that performance of TORA is better than AODV and DSR when the no. of node increased in a network but it cannot be necessarily that TORA will perform well, its performance may depending by varying the network.

In [18] comparison of four protocol DSDV, AODV, DSR, TORA has been performed with respect to modified path optimality, Network load deviation, Average End To end delay, and Jitter. DSDV has best average Jitter and then AODV, TORA and then DSR as given in order. DSDV performs well in weighted path optimality as comparison to TORA. Both DSDV and AODV having best result in reference of delay. DSR has performed well with respect to load balancing.

3. AD-HOC ROUTING PROTOCOLS

3.1 TYPES OF PROTOCOL

There are many routing protocol has been using in MANET. Each routing protocol has its own pros and cons in different scenario. In MANET, Routing protocol has been classified into three categories that are Proactive (DSDV, OLDR, and

WRP), Reactive (DSR, AODV, ACOR, and ABR) and Hybrid Routing Protocol (ZRP, TORA, ZRP, HSLS, and OORP).

3.1.1 Proactive Protocols

Proactive protocols are also known as table driven protocols because route to each node which are in network maintained in routing table. Packet are transmitted to node as predefined route as in routing table, the packet forwarding is done faster but routing overhead is greater because all the route have to be defined before sending the packet[1].DSDV,OLSR are example of proactive protocols.

3.1.2 Reactive Protocol

Reactive protocol is also known as on demand routing protocols. This routing protocol doesn't keep record of route and routing table so there is no overhead for maintaining the route to nodes. When a path establishes in network, the data packet sent immediately to the connected router that will send the request for the new route. The route searching is done using the flooding algorithm which says "just forward the packet to their neighbors" [1].This process repeat until it reaches the destination node. These protocol have low overhead of routing information but higher latency.

3.1.3 Hybrid Protocols

These type of protocol have combine feature of reactive and proactive protocol and takes advantage of both type so hybrid protocol have less time for route discovery and no overhead of routing information .ZRP,TORA are the example of hybrid protocol.

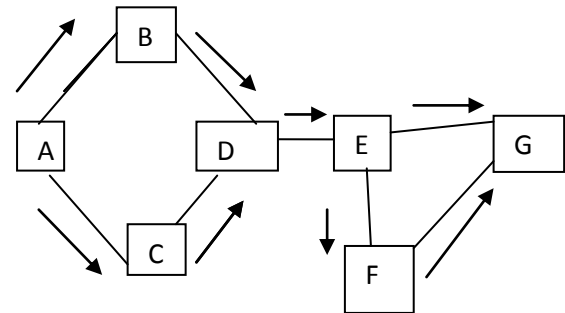
3.2 Overview of Experimental Evaluation of Routing protocols: DSR, TORA, LEACH

3.2.1 DSR (Dynamic Source Routing)

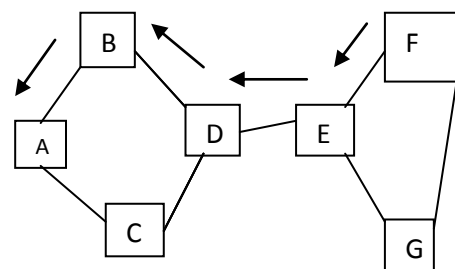
DSR is an easy and one of effective reactive routing protocol.dsr basically perform two operation first identify the route and maintain it until reaches to the destination.DSR also same as AODV, where RREQ and RREP messages are used. When any node want to send, it will check whether any node has already used followed the same path. If found then reaches to destination node, which holds an unexpired route to destination, RREP generated message and forward it back to the source. If it is an intermediate node then the route information will be added to the RREP. The advantage of this protocol is that there is no calculation for route is required but it need more connection set up time than proactive protocols.\previously used path will be used. If there is no route in cache then the source node broadcast the ROUTE REQUEST (RREQ) packet in entire network. This RREQ have ID, source and destination node address. When RREQ received, the node confirm for route to destination. Each

RREQ packet has TTL for validating time in network for a packet. When RREQ

ROUTE DISCOVERY (A TO G)



ROUTE REPLY (F TO A)



3.2.2 TORA (Temporally Ordered Routing Algorithm)

This is a Hybrid protocol with some proactive enhancement where a link between node is established by creating a directed acyclic graph (DAG) OF the route from source node to the destination node that no two node will have same height.[2]

TORA is designed to discover route on demand and provide multiple route to the destination .it seeks the route quickly and minimize the communication overhead by localizing algorithm reaction to topological change when possible. This protocol performs three basic operations

- Route discovery
- Route maintenance
- Route deletion

TORA, like other reactive protocol also first search the route to the destination by using shortest path and all invalid path is deleted from cache by sending CLR packet.

3.2.3 LEACH (Low Efficient Adaptive Clustering Hierarchy)

The goal of LEACH protocol is to increase the life of network. This is a cluster based routing protocol which utilizes randomize rotation of local cluster base station to equally circularize the energy load between the sensors in the network [3].

There is no need of node when its battery dies, so we use the LEACH routing protocol. This protocol allows us to space out the lifespan of the nodes, allowing it to do only minimum work it needs to transmit data.

The leach network is made up of nodes, some of which are called cluster-heads. the job of cluster head is to collect data from their surrounding node and pass it to the base station. Leach is dynamic because the job of cluster head rotates. Leach network has two phases

- Set up phase, where the cluster head chosen
- The steady phase, in this state cluster is maintain during transmission of data

4. SIMULATION MODEL

Network Simulator NS-2(version 2.35) is a discrete event simulator mostly used for research in networking. NS2 used for both wire and wireless network protocol and also with their function. NS-2 provides substantial support for simulation of TCP, routing and multicast protocols in wired and wireless (local and satellite). We use LIOWSN Project for simulation work [4].

A comparison and performance evaluation performed by NS2 for three routing protocols-DSR, TORA, LEACH. Simulation experiment result based on Throughput, Average jitter, End to End Delay, Packet Delivery ratio with the following parameter

TABLE 1: SIMULATION PARAMETER

Parameter	Value
Number Of nodes	10,20,30,40,50,60,70,80,90,100
Simulation time	100 m/s
Simulation model	Two Ray ground
MAC TYPE	802.11
Traffic Source	CBR
Packet size	512 byte
Area	500*500
Application	TCP
Node energy	5 joule
Node Speed	10 m/s
Pause time	10 m/s

5. PERFORMANCE MERTICS

The performance of network evaluated using different four metrics: throughput, Average Jitter, End to End Delay, and Packet Delivery Ratio.

5.1 THROUGHPUT

Throughput can be defined as how many data packets received by receiver with in data transmission time or successful data transmission performed within a time period. In any network throughput is average rate of successfully data packet delivered from source node to destination node. Throughput is represented in bits/bytes per second. In any network higher throughput is most essential factor.

5.2 End To End Delay

End to End delay of data packet is time taken by the packet from source node to destination node. End to end delay time include all the delay taken by router to seek the path in network consumption, propagation delay, processing delay and End to end delay for packet p which was sent by the node n, as a source node and received successfully at destination node is

$$\text{Endtoend delay}_{np} = \text{starttime}_{np} - \text{endtime}_{np}$$

Where starttime_{np} is the time when sending of packet p at node n starts, endtime_{np}, is the time when packet p is send by node n is received successfully at destination node.

5.3 Jitter

Jitter is the deviation of signals over a time period. More formally in a particular stream of packet, S_i is the time when packet i was send from the sender, R_i is the time is was received by the receiver, the jitter of packet I is given by

$$J_i = |(R_{i+1} - R_i) - (S_{i+1} - S_i)|$$

We will use the above definition for calculating the Jitter of all packets and then obtain the average jitter.

5.4 Packet Delay Ratio

Packet delay ratio is the ratio that is use to calculate the number of data packet transmitted by the source node and no. of data received by the destination node. It is used to calculate the loss rate of data packets while during data transmission in network. It evaluates the loss rate and measures up both the correctness and efficiency of ad-hoc routing protocols. A higher packet delivery ratio is hoped in any network.

$$\text{Packet Delay Ratio} = \frac{\sum \text{Number of packet receive}}{\sum \text{Number of packet send}}$$

6. SIMULATION RESULT

6.1 Throughput

Throughput of the network is calculated by extracting the data from tcl file and three curve for protocol: DSR,TORA,LEACH, by taking the no. of node 10,20,30,40,50 ,60,70 ,80,90,100 on X axis and No. of packet 3000, 3500,4000,4500,5000,5500,6000,6500,7000, 7500 on Y Axis as shown in given Figure 1 . It is visible that as the no. of node is increase throughput is decreasing. But variation of DSR is as lesser as than LEACH and TORA protocol because increased overhead. As LEACH is unpredictable so curve of throughput has much variation and does not depend on as no of node is increasing.

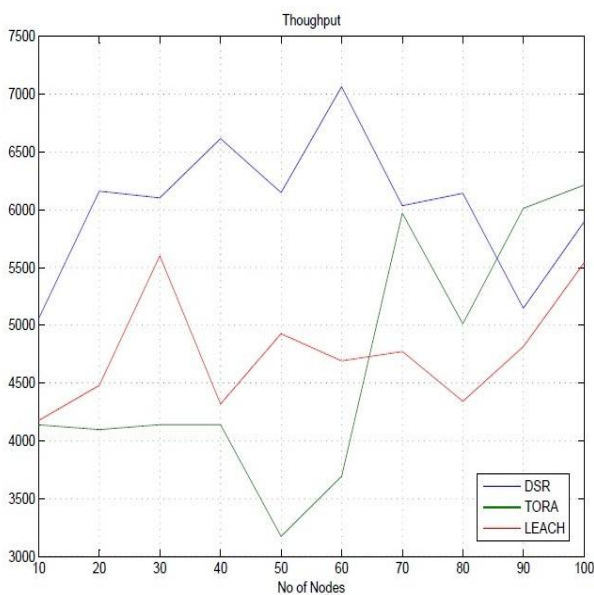


Figure 1: THROUGHPUT OF DSR, TORA,LEACH

6.2 End To End Delay:

End to End Delay is DSR is higher than TORA and LEACH because route discovery is required is DSR and then packet is forwarded. But as in LEACH (in fig.2) since packet is forwarded from source node to destination node by broadcasting so there is no route discovery mechanism is

needed.

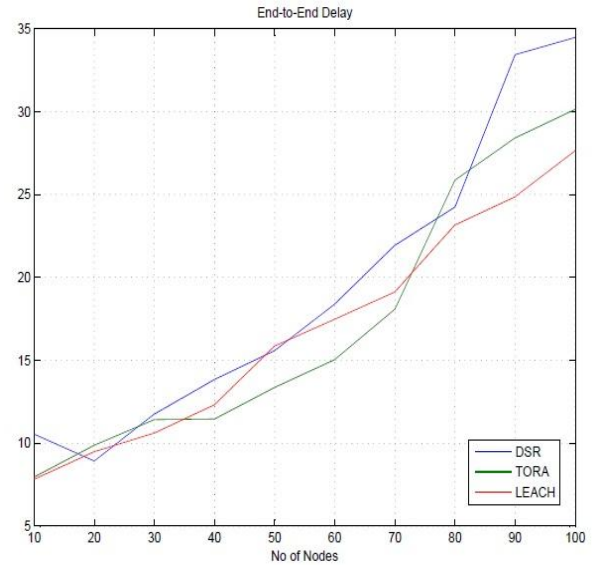


Figure 2: End to End Delay

6.3 Average Jitter

As it is clear from the fig.3, the curves of all three protocols have slightly variation with increasing order. The average Jitter of DSR is .696 ms, LEACH with 0.60 and TORA with 0.653, so LEACH has less average jitter as comparison to other two DSR, TORA protocol.

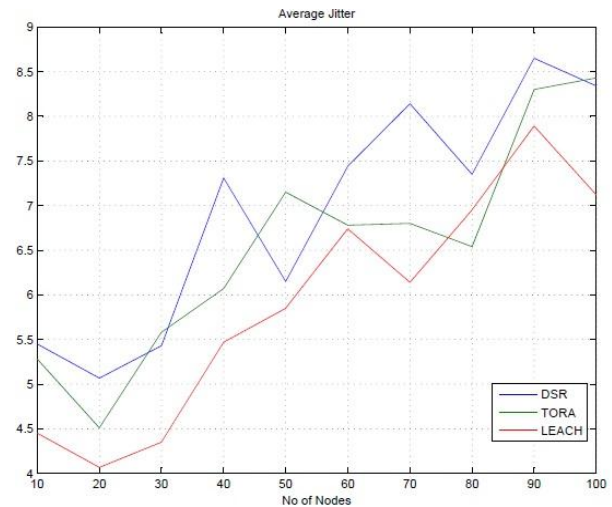


Figure 3: Average jitter

6.4 Packet Delivery Ratio (PDR)

Packet delivery ratio is calculated for all three protocols, As in fig:4,X axis showing No of node and Y axis represents percentage at which packet are delivered. It is very clear the variation in packet delivery ratio in DSR is not so high as in TORA and LEACH.As the number of node increase the PDR in TORA and LEACH is decreasing. Performance of LEACH as comparison to TORA is highly degraded when node is network increased. In any Network higher PDR is essential.

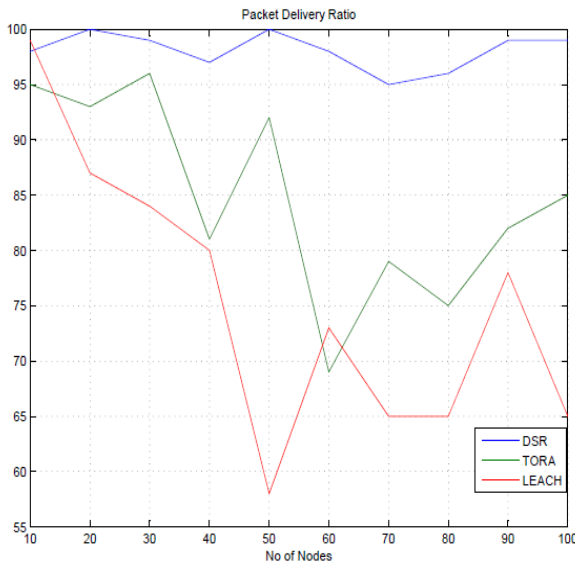


Figure 4: Packet delivery ratio

7. CONCLUSION

In this paper performance of MANET routing protocol: DSR, TORA, and LEACH using the NS-2 SIMULATOR (VERSION 2.35) have been analyzed. Each protocol has its own nature and gives variant performance in different scenario so no one protocol can be chosen best for all type of network. As per the simulation result based on Average jitter, Throughput, Packet delivery ratio, End to End Delay, Performance DSR is much better since it has higher Throughput, Packet delivery Ratio even the no. of node are increasing in network. Since DSR use table driven strategy for packet forwarding so its overhead increase when network has traffic. So DSR does not perform well in End to End delay, also has higher Average Jitter. TORA use a graph call DAG (directed Acyclic Graph) for path discovery so takes less time. TORA takes less End to End delay time as comparative to DSR. The performance of TORA is worst in case of Average Jitter and throughput. Leach performs best in case of end to end delay and throughput but having worst result is case of Packet Delivery ratio.

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