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Comparative Performance Analysis of Routing Protocols in Mobile Ad-Hoc Networks

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ABSTRACT: 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.This research paper describes the characteristics of ad hoc routing Protocols Ad-hoc On Demand Distance Vector Routing (AODV), Temporally Ordered Routing Algorithm (TORA), Destination- Sequenced Distance-Vector Routing (DSDV) based on the performance metrics like packet delivery fraction, Average delay, Normalized Routing load, Throughput and Jitter under low mobility and low traffic network as well as under high mobility and high traffic network. Results show that AODV has maximum throughput under low traffic and DSDV has maximum throughput under high traffic. As network becomes dense DSDV performwell in terms of Throughput than AODV and TORA. TORA performs well in dense networks in terms of packet delivery fraction but at the same time Normalized Routing load of TORA is maximum among all the protocols in both the networks. DSDV has least Normalized Routing load in both low and high traffic.

KEYWORDS: MANET, AODV, TORA, DSDV, Routing

I. Introduction

The history ofwireless networks started in the 1970s and the interest has been growing ever since. 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 veryfrequent, 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 [1].

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, since the objectives of how routing should take place is often unclear because of the different resources like bandwidth, battery power and demands like latency.

Routing protocols is one of the challenging and interesting research areas. There are different categories of MANET routing protocol, e.g. Proactive, reactive, flow-oriented, adaptive, hybrid, hierarchical, geographical, power-aware, multicast, and many other routing protocols. Each category contains different routing protocols developed according to some specific domain requirements. Mostly, proactive, reactive and hybrid protocols are of high importance due to their algorithm implementation and applications support.

II. Related work

In previous literaturevarious protocols have been compared using different parameters. In [2] two reactive protocols have been compared. In [3] Ad-Hoc On Demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR) and Temporally Ordered Routing Algorithm (TORA) Protocols have been compared using packet delivery fraction and end to end delay. In [4] Proactive and Reactive protocols have been compared. In [5] AODV, DSR and Optimized link State Routing (OLSR) have been compared using packet delay, network load and throughput. In [6] AODV, DSR, Destination Sequenced Distance-Vector (DSDV) and TORA have been compared based upon number of packets

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transmitted, lost, bit rate and packet delay. In [7] OLSR,AODV and TORA have been compared using packet delivery ratio, end-to-end delay and routing overload. In previous work done, the application where these protocols can be used in the best way is not identified based upon the results of comparison. In the proposed work, three commonly used protocols i.e. Ad hoc On Demand Distance Vector Routing (AODV), Temporally Ordered Routing Algorithm (TORA), Destination-Sequenced Distance-Vector Routing (DSDV) have been picked and compared. The comparison has been done using five parameters i.e. Throughput, Average End-to-End Delay, Average Packet Jitter, Normalized Routing Load, Routing Overhead and Packet Delivery Fraction. The most efficient routing protocol to be used for different applications has been identified based upon the results of the comparison.

III. **ROUTING PROTOCOLS**

A. *Ad-Hoc On Demand Distance Vector Routing (AODV)*

AODV uses different messages to discover and maintain links. In route discovery, a node broadcasts a Route Request (RREQ) to all nodes in the network till either the destination is reached or another node is found with a valid route entry for the destination whose associated sequence number is at least as great as that contained in RREQ. Then a Route Reply (RREP) is sent back to the source and the discovered route is made available. In route maintenance, when a node detects that a route to a neighbour node is not valid, it removes the routing entry and sends a Route Error (RERR) message to the active neighbours that use the route. This procedure is repeated at nodes that receive RERR messages.

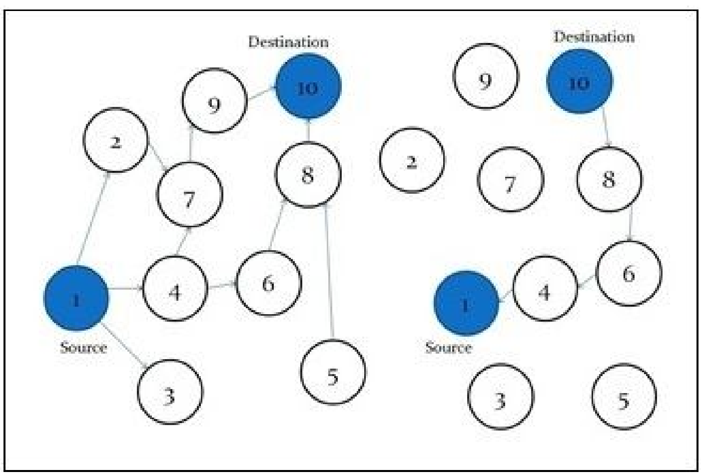

Fig.1: Aodv Route Discovery Process

B. *Temporally-Ordered Routing Algorithm Protocol (TORA)*

It is a highly adaptive, proficient and scalable distributed routing algorithm based on the concept of link reversal. Principal feature of TORA is that control messages are localized to a very small set of nodes near the occurrence of a topological change. The protocol has three essential functions: Route creation, Route maintenance and Route erasure. Route creation in TORA is made using QRY and UDP packets. The route creation algorithm starts by setting the height of destination to 0 and for all other nodes to NULL. The source broadcasts a QRY packet with the destination node's id in it. A node with a non-NULL height responds with a UDP packet that has its height in it. A node receiving a UDP packet sets its height is considered upstream and anode with lower height downstream. In this way a directed acrylic graph is constructed from source to the destination. The subsequent formation of route on TORA is done by

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transferring request from source and receiving reply from destination. During the route creation and maintenance phases, nodes use a height metric to establish a directed acyclic graph (DAG) rooted at destination. During the times of mobility the DAG is broken and the route maintenance unit comes into picture to re-establish a DAG routed at the destination.

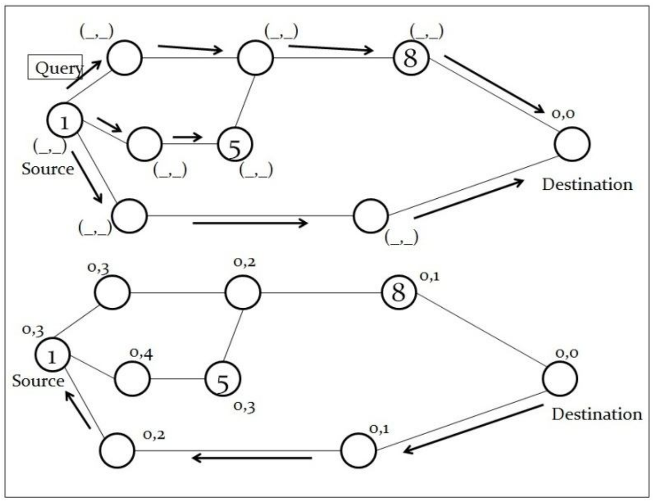

Fig.2: Route Creation in TORA

C. *Destination Sequenced Distance Vector Routing (DSDV)*

DSDV is also unicast, table driven, proactive MANET protocol used for routing based on Bellman Ford algorithm with improved routing mechanisms to obtain good performance. It is an enhancement to distance vector routing for ad-hoc networks. DSDV is basically a distance vector with small adjustments to make it better suited for ad-hoc networks. These adjustments consist of triggered updates that will take care of topology changes in the time between broad casts. Every node consists of two routing tables that are forwarding packets and advertised packets (incremental routing packets) to obtain imminent routing information Probability to suit best metric. DSDV routing table entry contains information about next hop destination address, a complete cost metric of destination routing path and sequence number. Destination creates a sequence number in DSDV for distinguish between stale and fresh routes to avoiding loops.

IV. PERFORMANCE EVALUATION

In this Paper, we are evaluating the following performance metrics of protocols by using network simulators.

A. *Average End-to-End Delay*

This metric represents average end-to-end delay. It indicates how long it took for a packet to travel from the source to the application layer of the destination.

B. *Packet Delivery Ratio*

Packetdelivery ratio is calculated by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source (i.e. CBR source).

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C. *Normalized Routing Load*

It is defined as Number of routing packets transmitted per data packet delivered at destination. Each hop-wise transmission of a routing is counted as one transmission.

D. *Throughput*

It is the ratio of total amount of data which reaches the receiver from sender to the time it takes for receiver to receive the last packet.

E. *Packet Jitter*

It is the variation in the delay of received packets. At the sender they are evenly spaced intervals, but due to traffic congestion, improper queuing or configuration errors they come at unequal intervals.

V. SIMULATION RESULTS

For comparing the performance of all the three protocols, two scenarios have been taken. First scenario is low mobility and low traffic and second scenario is high mobility and high traffic.By observing the table 1 and 2, it is found that AODV has maximum throughput under low traffic and DSDV has maximum throughput under high traffic. As network becomes dense and DSDV perform well in terms of Throughput than AODV and TORA. TORA performs well in dense networks in terms of packet delivery fraction but at the same time Normalized Routing load of TORA is maximum among all the protocols in both the networks. DSDV has least Normalized Routing load in both low and high traffic. DSDV give the least Jitter and Average Delay in both networks.

Performance Metrics	PROTOCOLS		
	AODV	TORA	DSDV
Jitter (sec)	3.73	0.59	0.39
Average Delay (sec)	39.84	9.74	8.43
Throughput (bps)	251.37	230.889	237.09
Normalized Routing load	0.003	0.02	0.001
Packet Delivery Fraction	0.92	0.845	0.866

Table 1: Low mobility and low traffic

Performance Metrics	PROTOCOLS		
	AODV	TORA	DSDV
Jitter (sec)	226.5	698.8	9.09
Average Delay (sec)	2706.3	3796	2602.19
Throughput (bps)	149.92	233.8	338.72
Normalized Routing load	0.027	0.045	0.005
Packet Delivery Fraction	0.036	0.0843	0.471

Table 2: High mobility and High traffic

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VI. CONCLUSION AND FUTURE WORK

The applications like voice and video conferencing need more BW, so in this case DSDV can be used. The applications like video telephony, web games, etc. Require high throughput, so in this case AODV can be used under low mobility and low traffic and DSDV can be used under high mobility and high traffic. There is high mobility of users and network nodes at the time of emergency and military operations. We have also observed results apart from this paper work that as the mobility increases there is an improvement in the throughput of OLSR, DSR and DSDV. So these three protocols can be used in emergency and military applications.

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BIOGRAPHY

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