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Scenario Based Performance Evaluation of DSR and AODV Routing Protocols

P.Kuppusamy[1], Dr.K.Thirunavukkarasu[2], Dr.B.Kalaavathi[3]
[1]*Dept. of Computer Science and Engineering, Vivekananda College of Engineering for Women, Namakkal, India*
[3]*Dept. of Information Technology, K.S.R College of Technology, Namakkal, India*

***Abstract*— Mobile Ad hoc Network (MANET) is a temporary network with collection of nodes with dynamic infrastructure. It requires efficient routing protocols to provide better data transmission. A number of protocols have been implemented for efficient routing and packet transmission. Some of the protocols have been proposed in the literature based on their characteristics. This research paper presents the evaluation of DSR and AODV on demand routing protocols based on packet delivery ratio, end to end delay with respect to i) Number of CBR nodes ii) Pause Time. The simulation is done using the QualNet 5.0.1 simulator.**

***Keywords*—MANET, AODV, TORA, routing**

I. Introduction

MANET consists of a set of mobile nodes, which communicate over radio regardless of the presence of infrastructure. Routing is a core problem in networks for sending data from one node to another. Routing protocols works well in wired networks does not show the same performance in mobile ad hoc networks due to the rapid change of topology. A MANET includes many challenges and issues such as Dynamic topologies, Frequency of updates or network overhead, energy, speed, routing and security. The routing protocol is required whenever the source needs to transmit and delivers the packets to the destination. In proactive protocols, each node maintains individual routing table containing routing information for every node in the network. Each node maintains consistent and current up-to-date routing information by sending control messages periodically between the nodes which update their routing tables. The drawback of proactive routing protocol is that all the nodes in the network always maintain an updated table DSDV [4]. In Reactive routing protocols, when a source wants to send packets to a destination, it invokes the route discovery mechanisms to find the route to the destination. The route remains valid till the destination is reachable or until the route is no longer needed. Unlike table driven protocols, all nodes not maintain up-to-date routing information DSR [8] and AODV [4].

II. Protocol Description

A. Dynamic Source Routing Protocol

The distinguishing feature of DSR is the use of source routing. That is, the sender knows the complete hop-by-hop route to the destination. These routes are stored in a *route cache*. The data packets carry the source route in the packet header.

Route Discovery

When a node in the ad hoc network attempts to send a data packet to a destination for which it does not already know the route, it uses a *route discovery* process to dynamically determine such a route [8]. Route discovery works by flooding the network with *route request* (RREQ) packets. Each node receiving an RREQ rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a *route reply* (RREP) packet that is routed back to the original source. RREQ and RREP packets are also source routed. The RREQ builds up the path traversed across the network. The RREP route's itself back to the source by traversing this path backward. The route carried back by the RREP packet is cached at the source for future use.

Route Maintenance

If any link on a source route is broken, the source node is notified using a *route error* (RERR) packet. The source removes any route using this link from its cache. A new route discovery process must be initiated by the source if this route is still needed. DSR makes very aggressive use of source routing and route caching.

B. Ad hoc On Demand Distance Vector Routing Protocol

AODV [1], [4], [5] is an enhancement of Destination-Sequenced Distance-Vector (DSDV) routing protocol algorithm which contains the characteristics of DSDV and DSR. Each node maintains a route table contains routing information but does not necessarily maintain routes to every node in the network and tremendously minimize the requirement of system wide broadcasts.

Route Discovery

When a source node desires to transmit the packet to its destination, the entries in the route table are verified to ensure whether there is a current route to that destination node or not. If it is there, the packet is forwarded to the appropriate next hop toward the destination. If it is not there, the route discovery process is initiated to locate the destination. The source node broadcasts a control message RREQ with its IP address, Route Request ID (RREQ ID), and the sequence number of the source and destination. While, the RREQ ID and the IP address is used to uniquely identify each request, the sequence numbers are used to determine the timeliness of each packet. To minimize network wide broadcasts of RREQ, the source node uses an *expanding* ring search technique. The fig.2 illustrates the route discovery process by broadcasting RREQ. The RREQ receiving node set the backward pointer to the source node and generates a RREP unicast packet with a lifetime, sent back to the source if it is the destination or contains a route to the destination i.e. intermediate node. An intermediate node set up a reverse route entry with lifetime for the source node in its route table to process the RREQ and forwards a RREP to the source. When the RREP reaches the source node, it means a route from source to the destination has been established and the source node can begin the data transmission. If the RREQ is lost during transmission, the source node is allowed to broadcast again using route discovery mechanism.

When an intermediate node receives RREQ from the source, it checks route table for valid route from source to its destination. If it is, copies its known sequence number for the destination into the Destination Sequence number field in the RREP message and RREP sent back to the source along the reverse path. If not, the intermediate node updates the forward route entry with preceding node into the precursor list and forwards the RREQ to its neighbor node.

Route Maintenance

A route discovered between a source node and destination node is maintained as long as needed by the source node. If the source node moves during an active session, it can reinitiate route discovery mechanism to establish a new route to destination. When either destination or intermediate node moves, the node upstream of the break initiates Route Error (RERR) message to the affected active upstream nodes. Consequently, these nodes propagate the RERR to their predecessor nodes. This process continues until the source node is reached. When RERR is received by the source node, it can either stop sending the data or reinitiate the route discovery mechanism by sending a new RREQ message if the route is still needed.

The AODV has great advantage in having less overhead over proactive protocols and it also supports both unicast and multicast packet transmissions even for nodes in constant movement. AODV responds quickly to the topological changes

III. SIMULATION MODEL

The simulation results presented in this paper were obtained using the QualNet simulator [1]. In our simulations we use the CSMA/CA 802.11a MAC protocol and use the RTS/CTS-Data/ACK mechanism. The traffic source is CBR (Constant bit rate) and nodes are spread across the network based on grid environment. The mobility model uses random way point model in a 1500 x 1500 m with 100 nodes. During the simulation, each node moves from a random source to a random destination. Once the node reaches the destination, it takes a pause time and again starts its journey to another chosen random destination. This process is repeated throughout the simulation and causing continuous changes in the topology of the network.

The simulation were performed with the different network scenario for different number of CBR communication sources, nodes mobility speed and pause times.

TABLE 1. SIMULATION PARAMETERS

Parameter	**Value**
Simulator	QualNet 5.0.1
Simulation Time	300 seconds
Protocols	DSR and AODV
Simulation Environment	1500 x 1500 m Grid
Transmission Range	250 m
Node movement model	Random waypoint
Traffic sources	Constant bit-rate (CBR)
Buffer Queue length	100

This paper has been considered the following metrics to evaluate the performance of ad hoc network routing protocols.

1) Packet Delivery Ratio: Packet delivery 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).

2) End-to-end Delay: This indicates how long it took for a packet to travel from the source to the destination. It includes all possible delay caused by buffering during route discovery latency, transmission delays at the MAC, queuing at interface queue, and propagation and transfer time. It is measured in seconds.

For packet j which was sent by source node i and received successfully at destination node, end-to-end delay is:

$$\text{End-to-end delay}_{ij} = \text{Start\_time}_{ij} - \text{End\_time}_{ij}$$

Where Start time_{ij} is the time when the sending of packet j at node i starts, End time_{ij} is the time when packet j is received successfully at the destination node.

IV. RESULTS AND OBSERVATIONS

The simulation results are shown in the following section in the form of graph. Graphs shown the comparison of the Packet delivery ratio, End to End delay for DSR and AODV protocols by varying the CBR sources and pause time.

A. *Packet Delivery Ratio*

Packet Delivery Ratio of AODV is better than the DSR in terms of CBR traffic sources and pause time. AODV delivers more than 80% packets up to 5 to 25 CBR traffic sources, but DSR delivers higher packets in low number of CBR traffic and packet delivery is decreased largely while increasing the CBR traffic (Fig.1). In case of Pause time, AODV delivers almost

80% whereas DSR delivers around 70 to 80% by varying from 0 sec to 25 sec (Fig.2). But AODV provides better packet delivery than DSR.

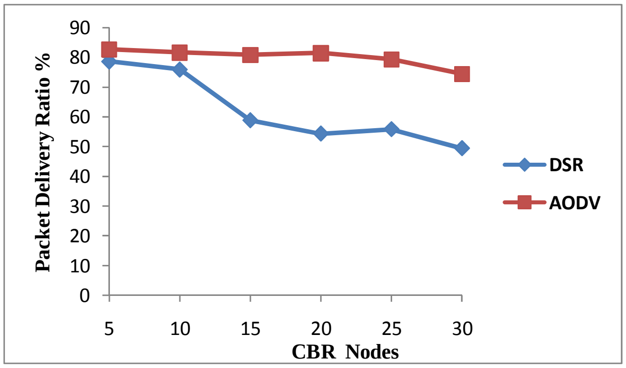

Fig.1 No.of CBR Nodes Vs Packet Delivery Ratio

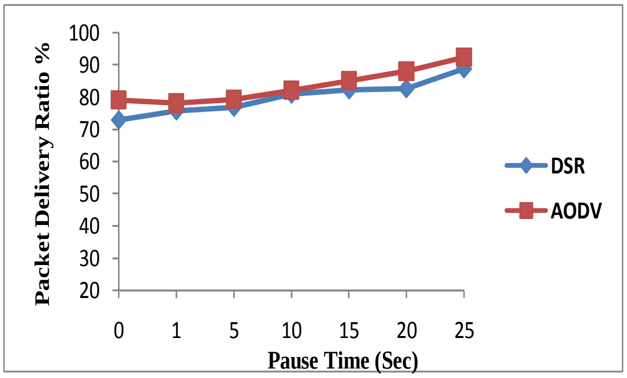

Fig.2 Pause Time Vs Packet Delivery Ratio

B. Average End to End Delay

Average end to end Delay of AODV is less as compared to the DSR by varying the number of CBR traffic sources from 5 to 30 sources. In AODV, delay increased very slightly whereas it varies largely in the case of DSR with respect to change the number of CBR traffic sources (Fig.3). In case of Pause time, AODV causes delay in 0 sec and almost remains very low from 10 sec. But in DSR it makes much delay in 0 sec and gradually decreased for large pause time at 25 sec (Fig.4).

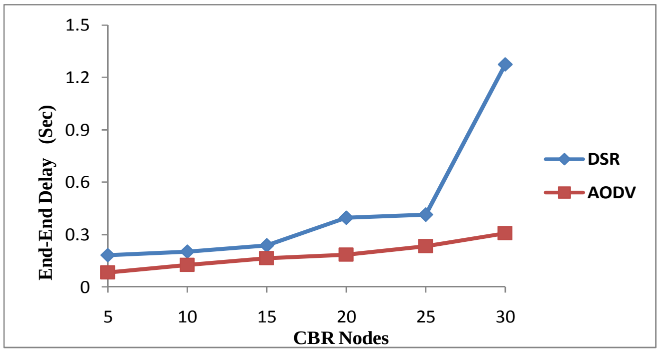

Fig.3 No.of CBR nodes Vs End to End Delay

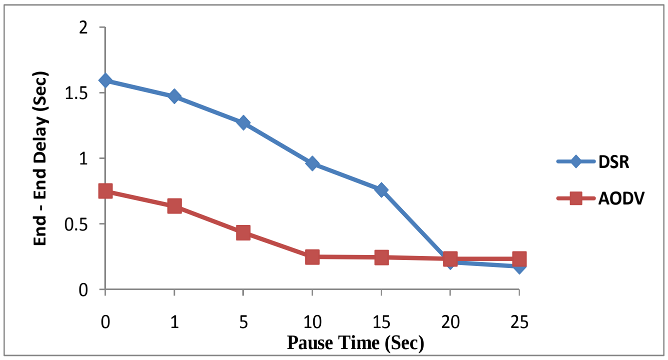

Fig.4 Pause Time Vs End to End Delay

V. CONCLUSIONS

This paper presents evaluation of DSR and AODV ad hoc routing protocols on the basis of end-to-end delay, packet delivery ratio performance metrics. The simulation results of these routing protocols shows that AODV is more efficient (more than 80%) than DSR (70% to 80%) in large number of CBR traffic nodes and low pause time. As well, DSR performs better at high Pause time, but it creates large delay at low pause time than AODV which provides small delay. It has been concluded that performance of AODV is better in large number of CBR traffic nodes and low pause time than DSR. The future work suggested that the effort will be made to evaluate these ad hoc network routing protocols to improve the data access and consistency with cooperative caching techniques.

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P.Kuppusamy received the B.E. (Computer Science and Engineering) degree from Madras University, in 2002 and M.E. (Computer Science and Engineering) degree from Anna University, Chennai in 2007. He is currently working as an Assistant Professor in Computer Science and Engineering, Vivekanandha College of Engineering for Women, Namakkal. He is a member of CSI INDIA and carrying out PhD research work in association with Anna University. His current areas of research interests are ad hoc networks and mobile computing.

Dr.K.Thirunavukkarasu received the B.E (Metallurgy with University Ranking) in Madras University in 1975 and M.Tech(Metal casting) in 1977and Ph.D degree in Mechanical Engineering from IIT Madras in 1983. He is currently working as a principal in Velammal Engineering College, Chennai. He is a member of MSITE, IWS INDIA. His current areas of research interests are robotics, Sensors, Signal Processing and Real-time Controls Integration and Mobile Computing.

Dr.B.Kalaavathi received the B.E. (Computer Science and Engineering) degree in 1993 from Bharathiyar University, Chennai, M.Tech from Pondicherry University in 2000 and Ph.D from Periyar University in 2010. She is currently working as a Professor in Information Technology, K.S.Rangasamy College of Technology, Namakkal. She is a member of CSI & ISTE INDIA. Her current areas of interest include Mobile Computing and Data Structures and Algorithms Analysis.