PERFORMANCE EVALUATION OF ROUTING PROTOCOLS FOR QOS MEASURES IN MANETS

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Abstract:

Mobile adhoc network (MANETS) is a collection of wireless nodes which dynamically creates a wireless network. The mobility of nodes in such type of network results in frequent changes making the routing in MANETs a challenging job. The routing protocols in MANETs should be more dynamic so that they quickly respond to topological changes. The routing table of each router in adhoc network must kept up-to-date. However, MANETS have specific characteristics like dynamic topologies, limited bandwidth and limited physical security. MANETS are mainly categorise in two types of routing protocol Proactive protocol (e.g. Distance Sequence Distance Vector- DSDV) and Reactive Protocol (e.g. Ad Hoc On Demand Distance Vector- AODV, Dynamic Source Routing- DSR). The present paper focuses on study and performance evaluation of these categories using NS2 simulations. The performance of the protocol is analyse by evaluating Packet delivery ratio, End to End delay and average throughput. The comparison shows that DSR performes better in terms of routing overhead.

Keywords- MANETS, Performance Evaluation, Routing protocol.

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I. INTRODUCTION:

Routing is a fundamental engineering task on internet. It consist of finding a path between source to destination. Routing is a bit complex in large networks because there may be many potential intermediate destinations a packet might traverse before reaching its desired destination [1]. To decrease complexity the network is divided into smaller domains. Considering each domain individually makes the network more manageable. In such networks there are various techniques for tracking changes in the network topology and rediscovering new routes when older ones break. Since ad hoc networks have no infrastructures there operations should be performed with collective cooperation of nodes. Routing protocol of such networks are divided into three basic types as Proactive Routing protocol, Reactive Routing protocol and Hybrid Routing protocol. The proactive protocol (e.g. OLSR)are table driven. They usually use link state routing algorithms. Link state algorithm maintains a full or partial copy of network topology and costs for all known links.

The reactive protocol (e.g. AODV) create and maintains routes only if they are needed, on demand. They usually use distance vector routing algorithms that keep only information about next hops to adjacent neighbours and costs for all paths to all known destinations. Thus, link state routing algorithm are more complex. The hybrid routing protocols try to combine proactive and reactive approaches based on certain conditions. ZRP for example defines a zone around nodes. Within that zone proactive routing is used, outside of it nodes use reactive routing [2].

Multicasting is the transmission of data-grams (packets) to a group of zero or more hosts identified by a single destination address. A multicast packet is typically delivered to all members of its destination host group with the same reliability as regular unicast packets . Multicasting reduces the communication cost for applications that sending the same data to many recipients instead of sending via multiple unicast, multicast reduces the channel bandwidth, sender and router processing and delivery delay. Multicasting protocol for the Adhoc network is On-demand Multicast Routing Protocol (ODMRP). The use of multicasting with the network has many benefits. Multicasting reduces the communication cost for applications that sends the same data to many recipients [4]. Multicast reduces the channel

Bandwidth , sender and router processing and delivery delay. In addition multicast gives robust communication whereby the receiver address is unknown or modifiable without the knowledge of the source within the wireless environment.

A lot of work has been done to evaluate the performance of routing protocols in adhoc networks. Thomas Kunz et al. [5] compared AODV and ODMRP in adhoc networks. Yadav et al. [6] studied the effects of speed on the performance of routing protocols in MANETS. Corson *et al.*[7] discussed the Routing protocol in MANET with performance issues and evaluation considerations. Guangyu *et.al*. [8] presented the application layer routing as Fisheye State Routing in Mobile Ad Hoc Networks. In view of need to evaluate the performance of ODMRP with other common routing protocols used now days, simulation based experiments are performed in this paper by evaluating Packet Delivery Ratio, End to End delay

and average throughput. Most common routing protocols are described in section II, section III show the experimental setup and results are evaluated and analyzed in section IV. Finally conclusion is given in section V.

II. ROUTING PROTOCOL:

There are several routing protocols proposed for wireless adhoc networks. Classification of routing protocols is as given below:

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

Proactive or Table-Driven routing protocols require each node to maintain up-to-date routing information to every other node (or nodes located within a specific region) in the network. On-demand routing protocols are designed to reduce the overheads in Table-Driven protocols by maintaining information for active routes only as and when required. Hybrid protocols combine the features of both proactive and reactive routing strategies to scale well with the increase in network size and node density. Following protocols are compared in this paper by evaluating the performance of each on the basis of PDR, end to end delay and throughput.

A. Distance Sequence Distance Vector (DSDV) Routing.

DSDV is a table driven routing protocol, routes to all destinations that are readily available at every node at all times. DSDV is enhanced version of the distributed Bellman-Ford algorithm where each node maintains a table that contains the shortest distance and the first node on the shortest path to every other node in the network. It incorporates table updates with increasing sequence number tags to prevent loops, to counter the count-to-infinity problem, and for faster convergence. The tables are exchanged between neighbours at regular intervals to an up-to-date view of the topology.

B. Adhoc On Demand Distance Vector (AODV) Routing.

AODV is a reactive protocol in which the routes are created only when they are needed. It uses traditional routing tables, one entry per destination, and sequence numbers to determine whether routing information is up-to-date and to prevent routing loops. An important feature of AODV is the maintenance of time based states in each node: a routing entry not recently used is expired. In case of a route is broken the neighbors can be notified. Route discovery is based on query and reply cycles, and route information is stored in all intermediate nodes along the route in the form of route table entries. The following control packets are used: routing request message (RREQ) is broadcasted by a node requiring a route to another node, routing reply message (RREP) is unicasted back to the source of RREQ, and route error message (RERR) is sent to notify other nodes of the loss of the link. HELLO messages are used for detecting and monitoring links to neighbors [10].

C. Dynamic Source Routing.

The DSR protocol presented is an on-demand routing protocol that is based on the concept of source routing. Mobile nodes are required to maintain route caches that contain the source routes of which the mobile is aware. Entries in the route cache are continually updated as new routes are learned. The protocol consists of two major phases: route discovery and route maintenance. When a mobile node has a packet to send to some destination, it first consults its route cache to determine whether it already has a route to the destination. If it has an unexpired route to the destination, it will use this route to send the packet. On the other hand, if a node does not have such a route, it initiates route discovery by broadcasting a route request packet. This route request contains the address of the destination, along with the source node's address and a unique identification number.

III. EXPERIMENTAL SETUP:

The evaluation is carried out with the NS2 to simulate adhoc network, by performing several experiments that illustrate the performance of the system. The simulation parameters like number of nodes, simulator area, pause time etc. as given in table 1 along with their respective values are used to examine the performance of the network. The values can be adjusted according to the requirements in ".tcl" file in NS2. After adjusting the values in this file, this file is executed. An output file ".tr" is used to check the various parameters to analyse the performance of network.

Table 1: Simulation parameters

parameters	**valve**
Simulator	NS 2.34
Simulator area	500m X 500m
Movement model	Random Waypoint
Number of Mobile Nodes	10-80
Pause time	0, 10, 20, 40, 70, 100, 200, 300, 400
Maximum speed	20 m/s
	DSDV, AODV & DSR
Traffic Sources	CBR
Simulation Time	900 sec.

IV. RESULTS:

The performance metrics used for evaluation are:

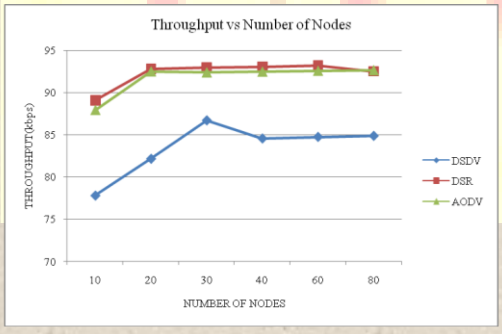
- Average Throughput
- Packet delivery ratio
- End-to-end delay
- Routing overhead

Based on different parameters, three routing protocols i.e. DSDV, AODV and DSR are simulated and analysed. All three protocols are evaluated by finding out average throughput, end-to-end delay, PDR and routing overhead by varying number of nodes and pause time using CBR traffic.

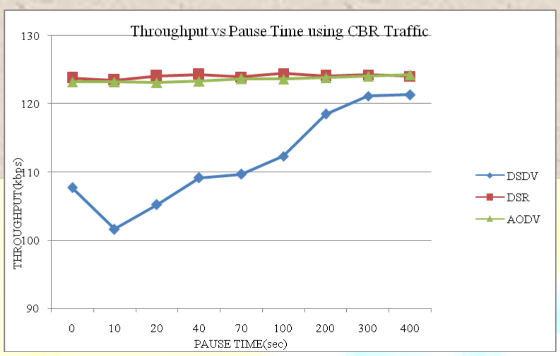
A. Average Throughput

Throughput indicates rate of communication per unit time. Throughput in these experiments is evaluated for all three routing protocols for varying number of nodes and pause time using CBR traffic.

Figure 1 shows the average throughput (kilo bytes per simulation time of 900 sec) for three protocols with changing number of nodes i.e. for 10, 20, 30, 40, 60 and 80 nodes. Average throughput is 84.87, 92.48 and 92.65 kbps for DSDV, DSR and AODV respectively.



The ability of protocols to deal with the route change by varying the pause time using CBR traffic is shown in figure 2. The value of Average throughput for three protocols by varying pause time is 112.33, 124.47 and 123.65 kbps for DSDV, DSR and AODV respectively.



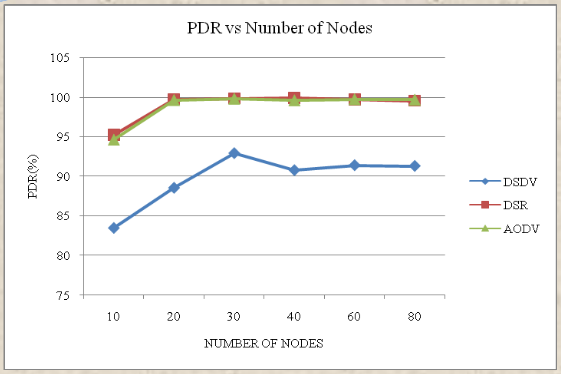
Hence average throughput has larger value for two reactive protocols than proactive protocol DSDV. Throughput should be of larger value for good protocol. It is clear that DSR has slightly larger value than AODV protocol. So, DSR is better protocol than the other two protocols when throughput use as metrics.

B. Packet Delivery Ratio

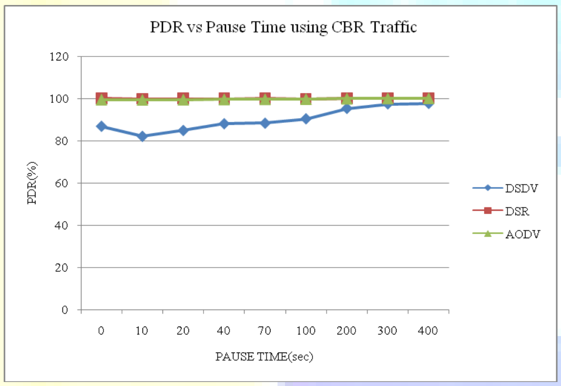
Packet delivery ratio (PDR) is number of successfully delivered legitimate packets to number of generated legitimate packets.

$$PDR = \frac{\text{Total number of packets received}}{\text{Total number of packets sent}}$$

A higher value of PDR indicates that most of the packets are being delivered to the higher layers and is a good indicator of the protocol performance. Average packet delivery ratio for DSDV is evaluated as 91.3131 , for DSR 99.5187 and for AODV is 99.627 as shown in figure 3.



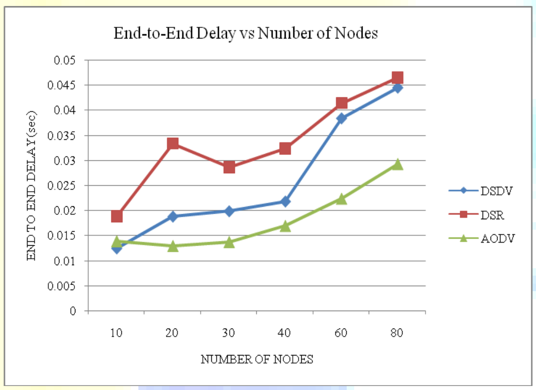
Average packet delivery ratio for DSDV with pause time using CBR traffic is 90.4022 , for DSR is 99.7805 , and for AODV is 99.6332 as shown in figure 4.



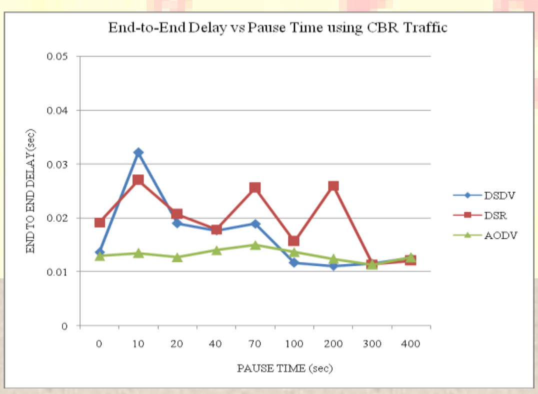
The above data reveals that the packet delivery ratio for reactive protocols AODV and DSR are more than proactive protocol DSDV and is approximately equal to unity i.e. most of the packets are delivered successfully to the destination. The PDR for DSDV is low for pause time but increases with increase in pause time. If we compare the performance of two reactive protocols DSR and AODV, it is clear from the data that PDR for DSR is slightly greater than AODV protocol.

C. End-to-End Delay

Network delay is the total latency experienced by a packet to traverse the network from the source to the destination. At the network layer, the end-to-end packet latency is sum of processing delay, packet transmission delay, queuing delay and propagation delay. The end-to-end of a path is the sum of the node delay at each node plus the link delay at each link on the path. A higher value of end-to-end delay means that the network is congested and hence the routing protocol does not perform well. The average end-to-end dealy for DSDV is 0.02174 , for DSR is 0.0323 and for AODV it is 0.0169 sec. as shown in figure 5.



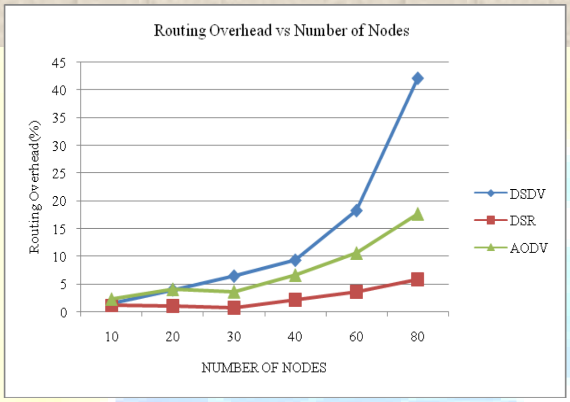
Average value of end-to-end delay for DSDV is 0.01171, for DSR is 0.01568 and for AODV is 0.01369 sec. When pause time using CBR traffic is varied as shown in figure 6.



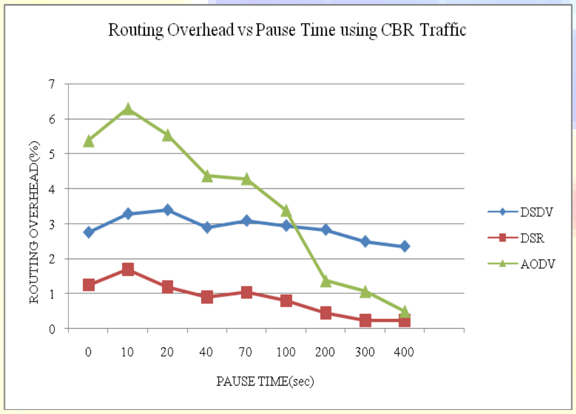
Hence it is clear from the figure that end-to-end delay is lowest for the AODV protocol. The delay for DSDV is less than DSR and hence end-to-end delay of DSR is better.

D. Routing Overhead

Routing overhead gives the total number of routing packets transmitted during the simulation. It is the ratio of routing packets to the total number of packets generated by the source. The value of average routing overhead for DSDV is 9.381 , for DSR is 2.191 and for AODV is 6.706 as shown in figure 7.



Average value of routing overhead for DSDV is 2.948, for DSR is 0.796 and for AODV is 3.380 when pause time using CBR traffic is varied as shown in figure 8.



The above figure shows that the routing overhead for DSR is found to be less when compare to AODV and DSDV. The overhead for AODV is more for low pause time pause time but with increase in value of pause time, routinf overhead decreases. Also as the number of nodes increases the routing overhead also increases for all three protocols but AODV performs better in casse of routing overhead for high value of pause time and with increasing number of nodes.

V. CONCLUSION:

In this paper performance analysis of Dynamic source routing (DSR) routing protocol has been done by comparing it with Ad-hoc on demand distance vector routing (AODV) and Destination Sequence distance vector routing protocols (DSDV) on the basis of four different performance metrics i.e. average throughput, packet delivery ratio, end-to-end delay and routing overhead. The simulation results shows that the Average throughput of DSR is better than DSDV and AODV with varying number of nodes and also with increase in pause time using CBR traffic. Packet delivery ratio for DSR is better than that of AODV and DSDV with changing number of nodes as well as with changing pause time. End to End delay for AODV is less than DSR and DSDV with varying number of nodes and pause time. Routing overhead for AODV is better than DSDV and DSR with increasing number of nodes and pause time. Finally from the above comparison it is concluded that DSR for adhoc networks perform well as compared to AODV and DSDV in terms of throughput, end to end delay and packet delivery ratio.

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