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Quality of Service Aware - Modified DSR Protocol in Mobile Ad-Hoc Network

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Abstract—A Mobile Ad hoc Network (MANET) is a collection of wireless mobile nodes forming an infrastructure less network that has no centralized manager. Recently the work on quality of service Guaranties in adhoc networks have attracted more attention. Routing is challenging task in MANETs due to the dynamic behavior. Multipath routing allows load balancing to use of multiple paths for routing between a source-destination pair. Load balancing is a general technique that is applied to achieve QOS in MANETs. Multipath routing can increase end-to-end throughput and provide quality of service in networks. It exploits the resource redundancy and diversity in the underlying network to provide benefits such as fault tolerance, load balancing, increase throughput, and improvement in QoS metrics such as delay and packet loss. In this paper a modified DSR protocol is purposed which extend the existing DSR protocol. The proposed work is implemented in NS2 and evaluates its performance and compared with existing protocol. The results shows that Modified DSR achieves a higher rate of successful packet delivery than existing best-effort ad-hoc routing protocols, such as the Dynamic Source Routing (DSR).

Keywords—MANET's, QoS Quality of Service, DSR Dynamic Source Routing.

I. INTRODUCTION

MANET[25] is a network having dynamic topology that consists of mobile nodes without base Station or centralized control. MANET is a self-organized and self configuring multihop wireless network. Due to the less transmission range of mobile node, multihop pattern is followed for passing the information. Packets passed through intermediate nodes while moving from source to destination. All mobile nodes perform functioning of routers that search and maintain routes to other nodes in the network. Routing is the act of moving information from a source to a destination in an internetwork. Mainly two type of routing protocols are used. Pro-active protocols (or table-driven protocols): they try to maintain an up-to-date map of the network, by continuously evaluating known routes and attempting to discover new ones. Reactive protocols initiate a route only when a node wants to start communication with another node. Route request and Route reply messages are used to discover and store the paths found from the source to destination. After finding the paths, suitable shortest path is selected by the source node for the transmission. Route discovered by reactive algorithms having problems like congestion problems as the centre of network carry more traffic. This causes poor performance in reactive protocol. To remove all these shortcomings, multipath routing protocols have been proposed. Multipath Routing is the act of moving information from a source to a destination in an internetwork using multiple paths. Multipath Routing [9] is the process of distributing the traffic load over multiple paths. Multipath algorithms permit traffic multiplexing over multiple lines. Multipath Routing provides better performance by proper utilization of network resources. Multipath routing protocols provides better throughput and reliability than unipath protocols. The objectives of multipath routing protocols [12] are to maintain reliable communication, to reduce routing overhead by use of secondary paths, to ensure load balancing, to improve quality of service, to avoid the additional route discovery overhead.

. Many multipath routing in ad hoc networks has been proposed in [9], [l I], [12], [15]. Although these protocols build multiple routes on demand, the traffic is not distributed into multipath. only one route is primarily used and alternate paths are utilized only when the primary route is broken. In this paper a modified DSR protocol is purposed that builds maximally disjoint paths. This algorithm searches for totally independent multipath with less cost and makes corresponding path policy to insure better end to end reliability. The rest of the paper is organized as follows: Section 2 reviews the previously work done on related algorithms. Section 3 describe proposed multipath routing protocol algorithm. Section 4 describes the performance evaluation of routing protocol. Conclusions are remarked in section 6.

II. RELATED WORK

In the recent period lot of research has been done in QOS based, multi-path and node disjoint routing. The recent studies extensively focused on the multipath discovering extension of the on- demand routing protocols in order to reduce single-path problems like AODV and DSR, such as high route discovery latency, frequent route discovery attempts and

possible improvement of data transfer throughput, reduce end to end delay, congestion reduce. Nasipuri et al. [14], focus on the use of disjoint paths. In their work they compares a protocol where only the source maintains two disjoint paths (Protocol 1) and a protocol where the source and all intermediary nodes maintain disjoint paths (Protocol 2). They find in all the cases they examined, Protocol 2 has a lower rate of path discovery. David B. Johnson, et.al [9] describes Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol. The protocol is composed of the two mechanisms of Route Discovery and Route Maintenance, which work together to allow nodes to discover and maintain source routes to arbitrary destinations in the ad hoc network. Roy Leung, et.al [11] proposed MP-DSR based on the existing DSR and takes advantage of its distributed on-demand nature. In MP-DSR First, define our QoS parameter of interest, end-to-end reliability. Second, propose a fully distributed QoS routing protocol, MP-DSR, with respect to this QoS parameter. Kui Wu, et.al [13] propose an on-demand method to efficiently search for multiple node disjoint paths and present the criteria for selecting the multiple paths. Lei Wang, et.al [15] define Multipath Source Routing (MSR) extension to DSR uses weighted round robin packet distribution to improve the delay and throughput. H. Zafar, et.al [7] provides benefit of fault tolerance, load balancing, bandwidth aggregation and the improvement in quality-of-service. Sung-Ju Lee, et.al [12] define SMR as another DSR extensions, SMR establishes and utilizes multiple routes of maximally disjoint paths. Providing multiple routes helps minimizing route recovery process and control message overhead. Dhirendra Kumar Sharma, et.al [4] enhances the performance of SMR protocols by using route update mechanism. Mamoun Hussein Mamoun, et.al [1] fined problems in QoS routing in MANET and introduce new routing algorithm (NRRA). Mujing Jin, et.al [6] defines an optimized scheme of SMR. Which allows the SMR having better performance in low-speed environment especially can decrease the end-to-end delay and also expands the range. A.Valarmathi, et.al [2] defines modification to original DSR protocol.DSR was modifying to monitor the occurrence of congestion by using multiple resource utilization thresholds as QoS. S.Venkatasubramanian [5] develops a Qos-based Robust Multipath Routing (QRMR) protocol for mobile ad hoc networks. Multipath allot weights to individual links depending on the metrics link quality, channel quality and end-to-end delay. V.Ramesh, et.al [3] proposes a congestion aware multi-path Dynamic Source Routing Protocol. The resultant protocol will generate set of highly disjoint paths and calculate the correlation factor between the paths to decrease the end to end delay. Fahimeh Rookhosh, et.al [8] describes stable tradeoffs between delay and routing load. Scheme uses two routes for each session; the shortest delay route and the one that is maximally disjoint with the shortest delay route. Lianfang Zhang, et.al [10] define load-balancing scheme for performance improvement of the multipath routing protocol. End to end delay improve and network resource utilized efficiently. \

III. A NEW TECHNIQUE: MODIFIED DSR

The proposed algorithm is based on DSR. DSR allows nodes to discover source route to any destination. The sender knows the complete hop-by-hop route to the destination. These routes are stored in a route cache. Each data packet sent then carries in its header the complete, ordered list of nodes through which the packet must pass. The main goal of Modified DSR is to build self-governing stable multiple paths. The source node finds out the information of multiple paths then the source node counts the hop of each path. From these it find out the shortest path between source to destination. This MDSR is based on DSR, it maintain the multipath Information table in which node disjoint and link disjoint paths are placed. From this table, path with the lesser hope count find out and used for route the data on mulipath. This approach is called Multipath Information (MPI).

The following are the additional notations used in the algorithm.

MP_{ij} : { Independent multipath from S to D} ;

$N(MP_{ij})$: { Number of multipath MP_{ij} };

H(P):{ Hop count of path};

P_{max} : Max($N(MP_{ij})$);

H_{max} : Max (Hop count of path(P)).

Modified DSR algorithm's aim is to get a multipath MP_{ij} which is subject to condition:

$N(MP_{ij}) \leq P_{max}$

$H(P) \leq H_{max}$

Pi and Pj are node disjoint;

$\prod Pi , Pj \in MP0 , I \neq j$

Modified DSR algorithm works as follows:

```
Begin
   Set n∈{  p_{i,1}(t_w),…….p_{i,l}(t_w)};
      MP_ij ← NULL
      P_max = 0
      H_max = 0
      N(MP_ij) = 0
      Judge = false
   While(N(MPij<l)and N(MPij)≤ P_max )
      { N(MP_ij) = N(MP_ij) +1;
         For(each neighbor node, set N ) {
               H_max = H_max +1
do
```



```
    Get the shortest path P by DSDV algorithm;
      if (P ≠ NULL & N(MP_ij) ≤ P_max & H(P) ≤ H_max)
          (MP_ij) ← MP_ij U {P};
          N(MP_ij) ← N(MP_ij) +1;
Delete the path P's intermediate nodes and their related links;
      }
         else Judge = true;
    }
         While (Judge==true)
         returnN( MP_ij);
    }
         P_max = P_max +1
}
```

IV. EXPERIMENTAL SETUP & PERFORMANCE METRICS

In order to demonstrate the effectiveness of Modified DSR, The performance of proposed protocol is compared with the performance of Dynamic Source Routing protocol (DSR). The proposed protocol is implemented using the Network Simulator (NS-2). In the simulation Modified DSR includes the "shorter route discovery" optimization method, presented in the previous section. To compare two on-demand ad-hoc routing protocol, it is best to use identical simulation environments for their performance evaluation.

The simulation environment consists of 50 mobile nodes in a rectangular region of size 1500×1500 meters. The nodes are randomly placed in the region and each of them has a radio propagation range of 300m. The constant bit rate (CBR) flows are deployed for data transmission. The random waypoint model is used for node mobility with varying pause time. It make use of ns-2.34 which has support for simulating a multi-hop wireless ad-hoc environment completed with physical, data link, and medium access control (MAC) layer models on ns-2. The evaluations are based on the simulation of two scenarios. In the first scenario, simulation of 50 wireless nodes forming an ad hoc network, moving about over a square (1500m x 1500m) flat space for 1000s of simulated time. In the second scenarios, the evaluations are based on the simulation of 50 wireless nodes forming an ad hoc network, moving about over a square (1500m x 1500m) flat space for varying simulated time from 1 to 7 minutes. A square space is chosen to allow free movement of nodes with equal density. To enable fair and direct comparisons between the routing protocols, identical loads and environmental conditions had to be maintained. Each simulator run accepts an input scenario file describing the motion of mobile nodes and also the sequence of packets originated by the mobile node, along with time of change in motion or packet origination pattern. In this simulation the traffic sources to be constant bit rate (CBR) source. The source and destination pairs were spread randomly over the network. Only 1024-byte data packets were used. Varying the number of CBR traffic sources was approximately equivalent to varying the sending rate. Hence, for these simulations It choose to fix sending rate at 4 packets per second, and used 2 different communication patterns corresponding to link connections.

Performance Evaluation Metrics

To compare the performance of DSR and Modified DSR the following performance metrics [1] are used:

Packet delivery ratio:- Packet delivery ratio is calculated by dividing the total number of data packets received at all the nodes, by the total number of data packets sent out by the CBR sources. Packet delivery ratio forms an important metric for performance evaluation of an ad hoc routing protocol because, given similar scenarios, the number of data packets successfully delivered at the destination depends mainly on path availability, which in turn depends on how effective the underlying routing algorithm is in a mobile scenario. This number represents the effectiveness and the throughput of a protocol in delivering data to the intended receivers within the network. Number of successfully delivered legitimate packets as a ratio of number of generated legitimate packets.

$$PDR = \frac{\text{Total no of packet received}}{\text{Total no of packet sent}}$$

Control overhead:- The routing load is defined as the total number of routing control packets normalized by the total number of received data packets.

Packet Loss:- The Packet Loss is defined as the difference between CBR packet sent from source sink and CBR packet received by destination sink.

TABLE 1. SIMULATION PARAMETERS

Sr. No.	Parameter	Value
1	Transmission range	300 meters
2	Bandwidth	2Mbps
3	Simulation time	1000 secs,1-7 min
4	Packet size	1024 bytes
5	Topology size	1500m x 1500m

6	Node Placement	Through .tcl file
7	Pause time	0-50s
8	Number of nodes	50
9	Mobility model	Random waypoint model
10	MANETs Routing Protocol	DSR, Modified DSR
11	No. of Connection	0- 5
	No. of trials	50
12	Data Traffic	CBR

MHz =Megahertz,, S = Seconds, Mbps = Mega bytes per seconds; mps=meter per second.

V. RESULT AND ANALYSIS

In the first scenarios, Simulator ran for 1000sec for given scenarios with pause times varying from 0 to 50 s and also maximum connections varying in between 0 and 5 connections. Packet delivery ratio, routing overhead, and number of packets dropped are calculated for DSR and MDSR. The results are summarized below with their corresponding graphs.

Packet delivery ratio

It shows that Modified DSR has a better PDR value when compared to DSR for each set of connections. This is because in the time waited at a node, Modified DSR can find an alternate route if the current link has broken whereas DSR is rendered useless at that point. Modified DSR outperform than DSR protocol but at initial PDR of both protocol is almost identical. Performance of protocol is as shown in graph.

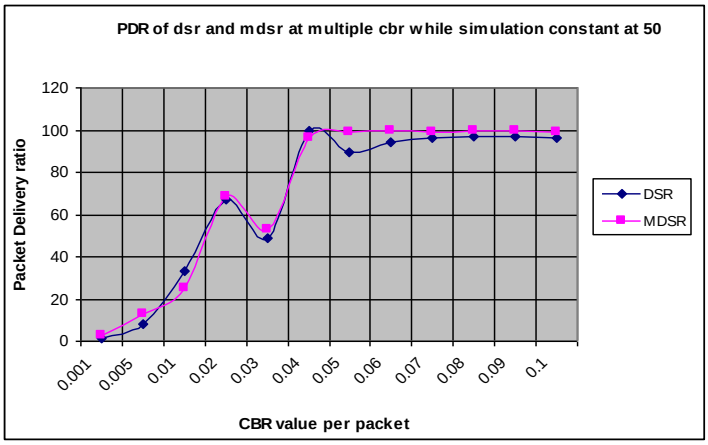

Figure 1: Packet delivery Ratio vs. CBR

Packets loss

The number of packets dropped in DSR is more than the number of packets dropped in Modified DSR. This is because of the fact that due to DSR being a uni-path routing protocol, if a link is broken, the packet will not be delivered to the destination node. Thus that packet will get dropped. But due to Modified DSR being a multipath routing protocol, even if the current link breaks, the network will find an alternate path from the source to the destination node and have a better chance of packet delivery; hence less number of packets will be dropped for MDSR.

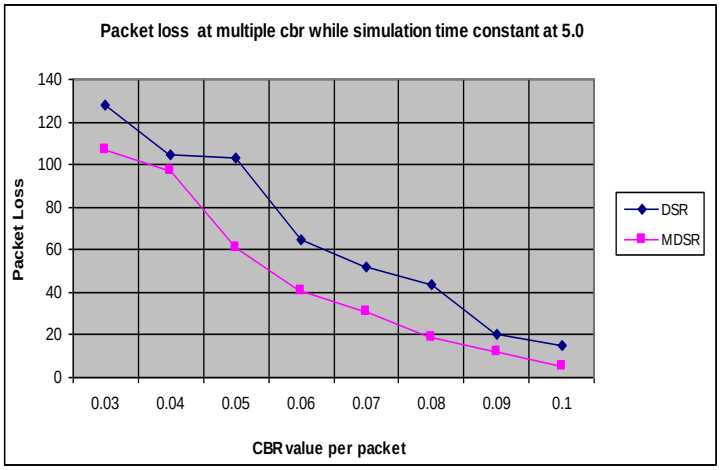

Figure 2: Packets Loss vs. CBR

Routing Overhead

From studying the graph for routing overhead, It shows that Modified DSR has more routing overhead that DSR for any range of CBR. This is attributed to the different mechanism of DSR and MDSR. Due to DSR being a unipath routing protocol, once a link breaks the packet delivery along that route stops. But MDSR is a multipath routing protocol and it searches for alternate paths if the current route breaks by flooding the network with RREQ packets. Hence MDSR incurs more routing overhead than DSR.

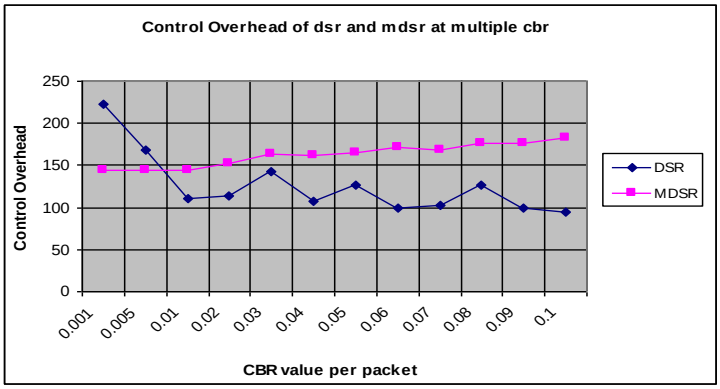

Figure 3: Control Overhead vs. CBR

In the second scenarios, Simulator ran for 50 nodes wit random waypoint mobility. Simulation Time varying from 1 min to 7 min. Packet delivery ratio, routing overhead, and number of packets dropped are calculated for DSR and MDSR. The results are summarized below with their corresponding graphs.

Packet delivery ratio

Fig 4 shows that Modified DSR has a better PDR value when compared to DSR as simulation time increases. As shown in the graph Modified DSR Performs 13% better then DSR. This is due to the reason thet as simulation time increase modified DSR find sitable alternate route to send the packet if the current link has broken whereas DSR has no choice at that point.

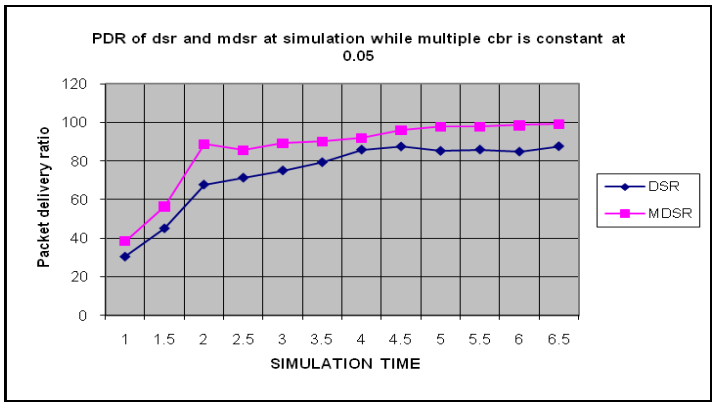

Figure 4: Packet delivery Ratio vs. Simulation Time

Packets loss

Fig 5 shows that number of packets dropped in DSR is more than the number of packets dropped in Modified DSR. In the intial stage DSR has maximum packet drop as simualtion time increases packet drop is less.This is due to the fact that DSR is a uni-path routing protocol and route stabalization come after some time otherwise more route break is there. Modified DSR route stabalize more quickly due to its multipath behavior.This is reason for less number of packets will be dropped for MDSR.

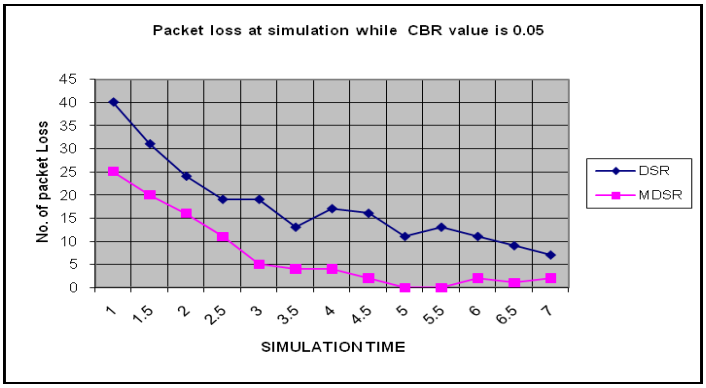

Figure 5: Packet Loss vs. Simulation Time

Routing Overhead

Fig 6 shows that Modified DSR has more routing overhead that DSR for different simulation time. As the simulation time increases the control packet in modified DSR is decreased but it is more then DSR protocol. This is due to the fact that Modified DSR having the multipath routing. To find the alternate route each node send more route request as compared to DSR. As simulation time increases routing overhead decline in both the cases.this is due to the reason that as simulation time increases more inforamation is maintained in the route cache an less time required to find the destination. Hence MDSR have 6% more routing overhead than DSR.

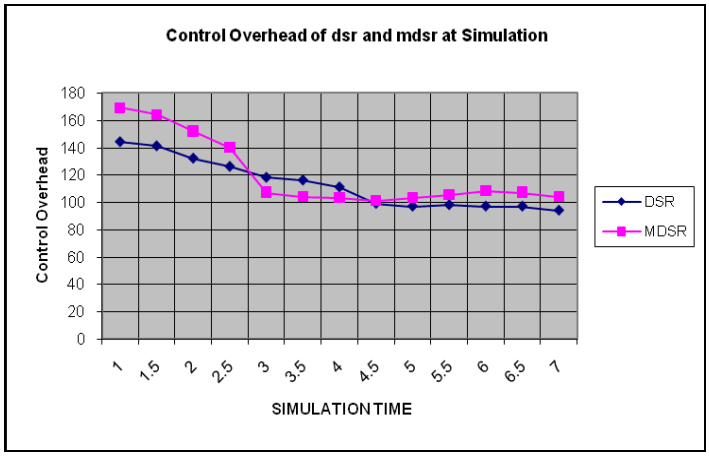

Figure 6: Control Overhead vs. Simulation Time

VI. CONCLUSION

In this paper the concept of multipath routing is implemented in wireless ad hoc networks. This paper provide descriptions of a number of multipath routing schemes proposed for wireless ad hoc networks, aiming at showing various strategies of utilizing multiple routings in wireless networks. In this paper, a new protcol is proposed modified dynamic source routing (MDSR) to provide data transmission with higher end-to-end reliability in wireless ad-hoc networks. The objective is to provide a reliable route for packet transmission with a minimum network overhead.In this algorithm, data transmission can then be soft provisioned with limited extra overhead. End-to-end reliability is also maintained throughout the whole transmission life time. Simulation results show that Modified DSR can offer higher and more consistent success delivery ratio than DSR. In addition, the lower error ratio of Modified DSR illustrates that its end-to-end transmission is more reliable.

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