

Evaluating the Performance of Modified DSR in Presence of Noisy Links using QUALNET Network Simulator in MANET

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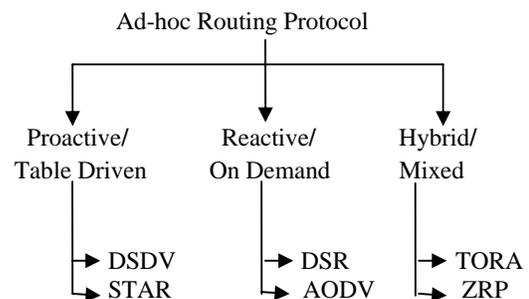
Abstract - For routing in MANET, finding the shortest path between nodes based on the classical hop-count metric may not always be the best routing criteria to be considered because the shortest path might be congested or error prone due to noisy interference leading to poor network throughput and packet delivery ratio. In our work, we use Signal-to-Noise Ratio (SNR) as the link-quality metric in a modified version of the of DSR protocol coined as MDSR which takes into consideration the SNR value of a wireless link in addition to the hop count metric to discover new routes. We have extensively used the QUALNET Simulator to evaluate our modified DSR protocol and the results indicate that the MDSR provides high throughput, high packet delivery ratio, reduced end-to-end delay and jitter in comparison to the original DSR protocol. We have compared the performance of DSR and MDSR in two different network topologies with 52 and 92 mobile nodes respectively. In each topology we have considered two cases one using DSR without considering the link SNR values and the other using MDSR on the same topology considering the link SNR values.

Keywords - MANET, DSR, MDSR, SNR, RREP, RREQ and RRL.

I. INTRODUCTION

1.1 Introduction to MANET

A Mobile Ad-hoc Network (MANET) is a collection of wireless mobile nodes capable of exchanging packets with each other without depending on any existing network infrastructure or any centralized administration. In MANET, each node behaves like a terminal as well as a router [7]. The terminals are generally mobile and change the network topology dynamically by their mobility. MANETs are capable of handling topology changes due to mobility, malfunctioning nodes and links through network reconfigurations. Routing protocols for MANET must be adaptive and capable of maintaining routes despite network topology changes. To ensure the proper functioning and management of the large scale ad hoc networks many routing protocol have been proposed so far. Depending on how the network information is obtained the routing protocols can be categorized as follows:



- Proactive/Table Driven: In Proactive protocol each host keeps one or more tables for maintaining the up-to-date routing information and it broadcasts the information throughout the network if there is any change in the network topology to maintain route consistency and currency [1] [3] [5] [6].
- Reactive/On Demand: It invokes the route discovery mechanism to find the destination and route the packet only when there is a packet to deliver. It is rather a lazy approach of routing and

its main motivation is the reduction of the size and maintenance overhead of the routing table [1] [3] [5] [6].

- Hybrid/Mixed: Combining the salient features of table driven and on demand routing protocols [1] [3] [5] [6].

1.2 Introduction to DSR

Due to the mobility of the nodes in ad hoc network, the routing protocols meant for wired networks are unsuitable for MANETs. For this, DSR (Dynamic Source Routing) [9] [4] can be used which follows two mechanisms –

1. Route Discovery
2. Route Maintenance.

It is an on-demand routing protocol without any periodic routing advertisement messages. Though DSR protocol hardly provides any QoS support, multicasting and security, it can easily adapt to changes like host movement without requiring considerable protocol overheads. DSR can switch easily between the extreme situations where movement of hosts is quick and frequent i.e. where flooding may be the best strategy, as well as infrequent movements which are almost static i.e. where conventional routing protocols are most suitable.

1.2.1 Route Discovery

It is a mechanism for finding the route to transmit data packets to a destination when the exact route is unknown to the sender. It uses flooding for route request (RREQ). After receiving RREQ, each node rebroadcasts it further, till the original destination is reached. After receiving the packet the destination replies back to the source with route reply (RREP). The route request records the route traversed so far in the route record list (RRL) for future use. The RREP follows that path backward to back to the source.

1.2.2 Route Maintenance

All the nodes in the network are updated with the routing information at regular intervals. DSR provides two types of packets for maintaining these routes

- A. Route Error Packets (REP) – which are used to notify about any broken link in the network. The node receiving the REP removes all those routes from its routing table, which uses the broken link and a new Route Discovery Process is initiated by the node.
- B. ACKs – which acknowledges the receipt of the REP packets.

II. LITERATURE SURVEY

Dynamic Source Routing protocol is developed for routing in mobile ad-hoc networks and was proposed for MANET by Broch, Johnson, and Maltz [4]. They have shown that in a large scale real life ad hoc network Dynamic Source Routing protocol (DSR) provides excellent performance because it has low routing overhead and cope up dynamically with network mobility which is an important characteristics of MANET. Moreover DSR can work with all the major mobility patterns in MANETs.

The DSR also takes the advantage of the existence of multiple paths between a source and destination node and dynamically chooses an alternative path when the original path ceases to exist due to link failure. During a link failure, those nodes that uses the link for routing data packets should be informed of the failure and should find alternative existing paths to route their data. Thus, DSR allows more than one alternative paths to a specified destination [8] [7].

III. MODIFIED DSR

To send data packet to a particular destination, at first the source checks for an already existent route and if there is no such route, the source will run a new route discovery mechanism by broadcasting a Route Request (RREQ) to its neighborhood. The RREQ packet includes an additional field, ROUTE_MIN_SNR, to store the minimum SNR value along the route path as it is the weakest link in the path and its throughput determines the route throughput. Upon receiving the RREQ, at first every node checks for the fact that if it is the intended destination itself. The non-destination nodes rebroadcast the packet to their neighborhood updating the ROUTE_MIN_SNR field with the SNR feedback from the physical layer in their neighborhood. When the destination node receives the RREQ packets, it compares the SNR value associated with each RREQ packet with the SNR threshold value (10dBm in our method). Among the possible paths one with the maximum SNR is selected as it gives the maximum throughput and minimum delay path. Then the destination node sends its Route Reply (RREP) packet through the selected reverse route path.

Algorithm: MDSR

If (DSR RREQ packets are received at an intermediate node N which is not the destination node M)

then do

{

Step 1. Calculate the SNR values of all the outgoing links at that node N.

Step 2. Select all RREQ packets received for a destination node M, having $ROUTE_MIN_SNR > SNR_{Threshold}$.

Step 3. Among the selected RREQ packets received for a destination node M, find out RREQ packet whose $ROUTE_MIN_SNR$ field has the highest value and temporarily select the advertised route.

Step 4. If there is an existing route to M in N's routing table then compare its $ROUTE_MIN_SNR$ with that of the advertised route.

Step 4a. If the advertised route has a higher $ROUTE_MIN_SNR$ then the existing route is temporarily entered in N's routing table replaced with the advertised route.

Step 4b. Otherwise advertised route not entered.

} /* end if */

else

{

Step 1. Among all the advertised routes to the source N find out the one having maximum $ROUTE_MIN_SNR$ value and temporarily select it.

Step 2. If there is an existing route to N compare its $ROUTE_MIN_SNR$ with that of the temporarily selected advertised one. If the latter is greater then it is made the permanent route otherwise it is discarded.

Step 3. RREP packets are being sent from M to N over the selected route and the intermediate nodes makes the necessary changes in their routing tables.

}

IV. SIMULATION SETUP

The Qualnet 4.5[10] network simulator is used for our simulation. We have considered two network topologies with the first one having 52 nodes with 3 different sources and destinations (Figure 1) and the second one having 92 nodes with 4 different sources and destinations (Figure 2) respectively. Two different packet sizes namely 512 bytes and 1024 bytes are chosen randomly. We have used User Datagram Protocol (UDP) as our transport layer protocol and in the application layer we have used Constant Bit Rate (CBR) data traffic applied between source and destination. Three CBR traffic are applied between three source nodes – 1, 7, 15 and destination nodes – 25, 34, 52 respectively in the first topology (figure 1.) and in the second topology between four source nodes – 7, 16, 25, 33 and destination nodes – 34, 52, 61, 92 respectively (figure 2.).

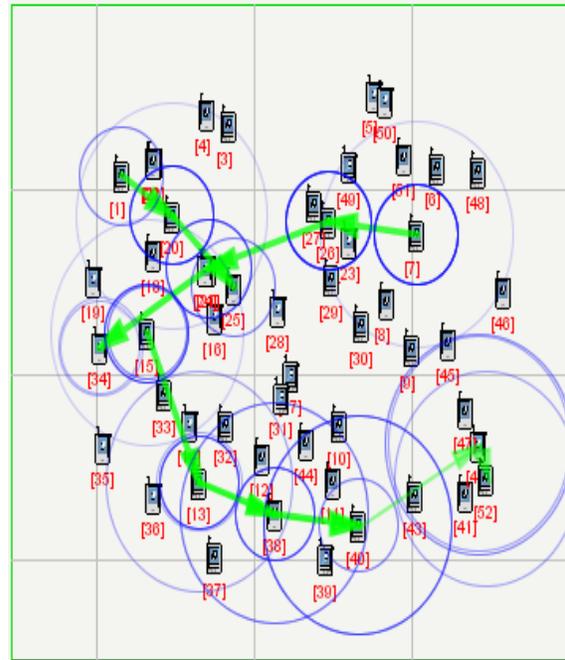


Fig. 1 : Scenario Design of 52 nodes & 3 different Source to Destination Traffic

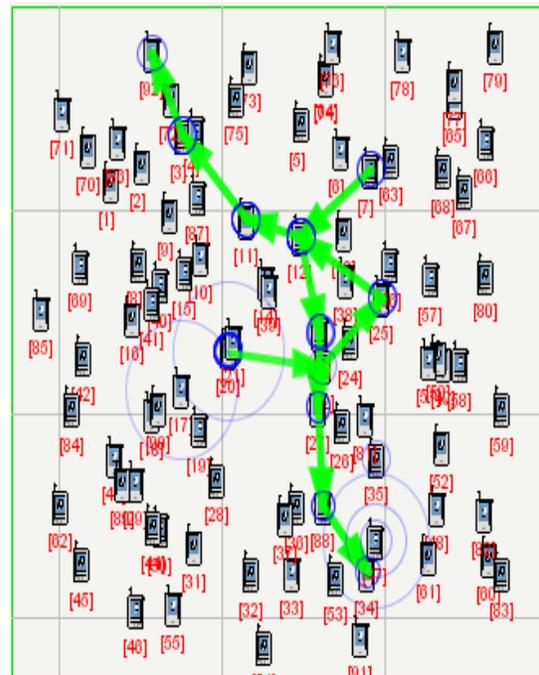


Fig. 2 : Scenario Design of 92 MANET nodes & 4 different Source to Destination Traffic

Table 1. Simulation Parameters

Parameter	Value
Area	1500m X 1500m
Data Rate	2 Mbps
Packet Size	512 bytes, 1024 bytes
Mobility Model	Random-Way Point
Physical Layer Radio Type	IEEE 802.11b, Abstract
MAC Protocol	IEEE 802.11
Antenna Model	Omni directional
Temperature	290 K
SNR Threshold	10 dBm

4.1 Performance metric.

4.1.1 Packet Delivery Ratio (PDR).

The Packet Deliver Ratio is defined as the ratio between the number of packets sent by the source to that received by the destination and is used to measure the performance of DSR in certain works [1] [2] [3].

4.1.2 End-to-End Delay.

The end-to-end packet delay is calculated as the time interval when the packet is sent by the source to the time when it is delivered to the destination node has been considered to measure DSR efficiency in [1] [2] [3].

4.1.3 Jitter.

Jitter is the variation of the packet arrival time and is an important metric for any routing protocol as shown in works [6].

V. RESULT AND DISCUSSION

The Qualnet 4.5 network simulator [10] is used to analyze the performance of Modified Dynamic Source Routing Protocol (MDSR) in comparison with original Dynamic Source Routing Protocol [4] [9]. Two different network topologies consisting of 52 and 92 nodes respectively as shown in figure 1 and figure 2 are used in the simulation. In figure 1 there are 3 source destination node pairs and in figure 2 there are 4 such node pairs all using CBR traffic. The packet sizes are randomly chosen as 512 or 1024 bytes. Here the performance is analyzed on three different parameter namely Packet Delivery Ratio, End-to-end delay and Jitter. The results are depicted in figure 3 to figure 8.

Packet Deliver Ratio (PDR) :

It is observed that the PDR obtained using MDSR is 10 to 15 percent more in comparison to DSR over the

same network topology and scenario as shown in figure 3 and figure 6 for the 52 node and 92 node MANET respectively and is calculated in table 2.

End-to-End Delay :

For almost all the data flows in both the network topologies and scenario it is shown that when MDSR is used there is a reduction of End-to-End delay by 20 to 25 percent as depicted in figure 4 and figure 7 in comparison to DSR. The average End-to-End delay is calculated in table 3.

Jitter :

Jitter, is the variation of the packet arrival time and is an important metrics for a routing protocol. In our simulation it is observed that the average jitter in DSR is higher than the MDSR. The results are shown in figure 5 and figure 8 and the average jitter is calculated in table 4.

	52 Nodes	92 Nodes
DSR	0.934	0.950
MDSR	0.973	0.994

Table 2. DSR vs. MDSR for Packet Delivery Ratio.

	52 Nodes (msec)	92 Nodes (msec)
DSR	0.083	0.131
MDSR	0.072	0.095

Table 3. DSR vs. MDSR for Average End-to-End Delay.

	52 Nodes	92 Nodes
DSR	0.027	0.036
MDSR	0.023	0.033

Table 4. DSR vs. MDSR for Average Jitter.

From the above results it can be concluded that considering the above three factors i.e. average delivery ratio, average end-to-end delay and average jitter, MDSR performs better than DSR in both topologies and scenarios. MDSR provides high packet delivery ratio and corresponding throughput and low end-to-end delay and jitter, in comparison to DSR under the same conditions.

VI. FUTURE SCOPE

From the results it is clear that the MDSR protocol adapts quickly to changes very effectively as it provides higher throughput and more bytes are received than the

original DSR protocol. It also reduces the end-to-end delay and Jitter.

In our work, we have studied the behavior of DSR under noisy environment and subsequently modified the protocol into MDSR and compared its performance with DSR. In future we plan to study the performance of AODV and other MANET routing protocols under noisy situations and find their modified version and to do a comparative study of the modified protocols on different parameters using Qualnet 4.5 network simulator. In our work we have considered that all the data flows are of equal priority which is quite unrealistic in real life situations. Modified protocols should prioritize data flows, so that higher priority data flows gets better parameter values. We can also consider load balancing in our modified protocol.

REFERENCES

- [1] P. Nand, and S.C. Sharma, "Performance study of Broadcast based Mobile Ad hoc Routing Protocols AODV, DSR and DYMO", Proc. International Journal of Security and Its Applications, Vol. 5, No. 1, January, 2011, pp. 53-64.
- [2] A. Kathirvel, and R. Srinivasan, "Analysis of Propagation Model using Mobile Ad Hoc Network Routing Protocols", Proc. International Journal of Research and Reviews in Computer Science (IJRRCS), Vol. 1, No. 1, pp. 7-14.
- [3] A. Suman, A.K. Nagar, S. Jain and P. Saurav, "Simulation Analysis of STAR, DSR and ZRP in Presence of Misbehaving Nodes in MANET", Proc. Manuscript received November 15, 2009.
- [4] D.B. Johnson, D.A. Maltz and J. Borch, "DSR : The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks", Computer Science Department Carnegie Mellon University Pittsburgh, PA15213-3891, <http://www.monarch.cs.cmu.edu>.
- [5] J. Liy, H. Kameday and Y. Panz, "Study on Dynamic Source Routing Protocols for MANET", Institute of Information Science and Electronics, University of Tsukuba, Japan. Department of CS, Georgia State University. University Plaza, Atlanta, GA 30303, USA.
- [6] P. Nand, S.C. Sharma and R. Astya, "Traffic Load based Performance Analysis of DSR, STAR & AODV Ad hoc Routing Protocol", Proc. (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 1, No. 4, October 2010, pp. 58-62.
- [7] N. Bhalaji, A. R. Sivaramkrishnan, S. Banerjee, V. Sundar, and A. Shanmugam, "Trust Enhanced Dynamic Source Routing Protocol for Ad hoc Networks", Proc. World Academy of Science, Engineering and Technology 49 2009, pp. 1074-1079.
- [8] S Sultana, S Begum, N Tara and A.R Chowdhury, "Enhanced-DSR: A New Approach to Improve Performance of DSR Algorithm", Proc. International Journal of Computer Science and Information Technology, Volume 2, Number 2, April 2010, pp. 113-123.
- [9] T. Demir, "Simulation of Ad Hoc Networks with DSR Protocol", NETLAB, Department of Computer Engineering, Bogazici University, 80815 Bebek, Istanbul, Turkey.
- [10] Scalable Networks Technologies: Qualnet Simulator 4.5 <http://www.scalable-networks.com>.

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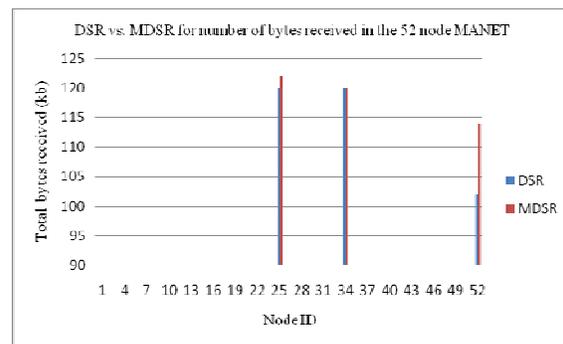


Fig. 3 : DSR vs. MDSR for number of bytes received in kb in the 52 node MANET.

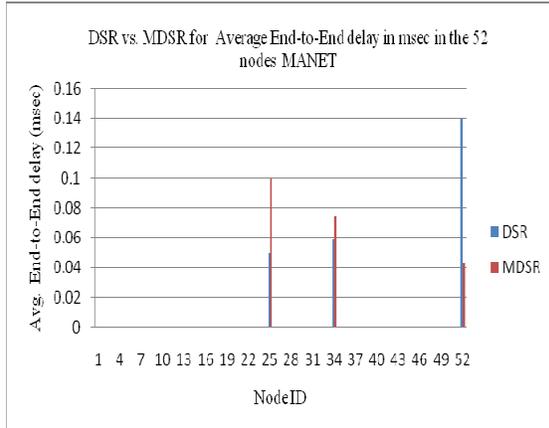


Fig. 4 : DSR vs. MDSR for Average End-to-End Delay in msec in the 52 node MANET.

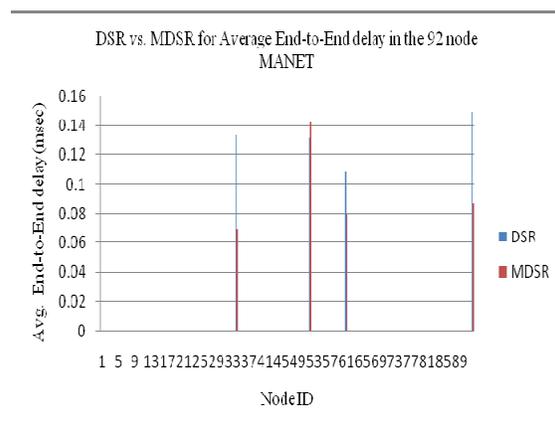


Fig. 7 : DSR vs. MDSR for End-to- End Delay in msec in the 92 node MANET.

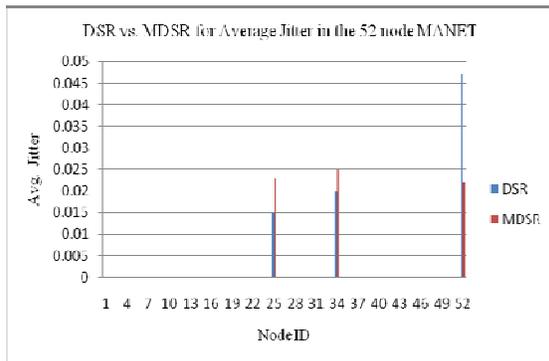


Fig. 5 : DSR vs. MDSR for Average Jitter in the 52 node MANET.

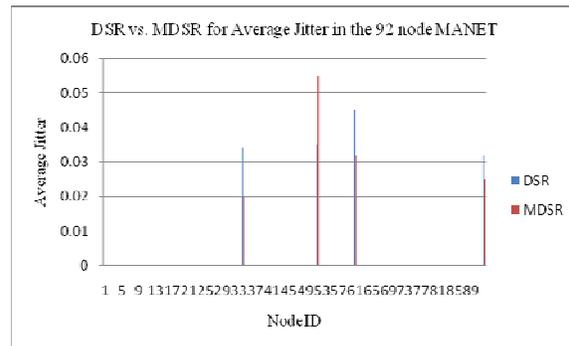


Fig. 8 : DSR vs. MDSR for Jitter in the 92 node MANET.

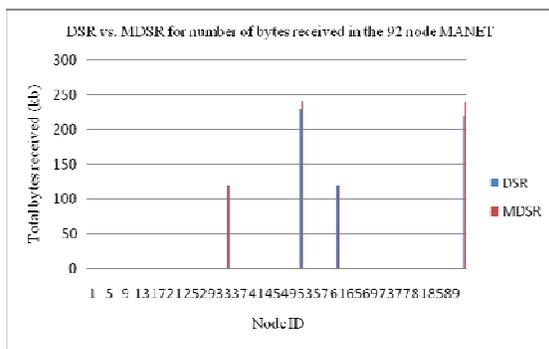


Fig. 6 : DSR vs. MDSR for number of bytes received in the 92 node MANET.

