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Dynamic Multi Constraint Routing Based Efficient Data Transmission in MANET for Improved Sink Point Streaming

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Abstract - The mobile adhoc network (Manet) has been identified as keen networking scenario in modern internet world. The most networking solutions have been enabled to access through mobile devices. The physical characteristics of mobile nodes keep changing the topology of network at each second. However, achieving higher streaming performance is most important in point of quality of service. There exist numerous techniques to route data packets between the source and sink/destination nodes, but suffer with poor performance. To overcome the deficiency, a dynamic multi constraint routing algorithm has been presented in this paper. The method considers different parameters like energy, lifetime, traffic, mobility speed, direction and hop count in route selection. According to the above mentioned parameters, the multi constraint algorithm estimates streaming support score (SSS) for any route to perform routing of packets. The algorithm improved routing performance of routing and increases the streaming rate in Manet.

Index Terms - Manet, Streaming Support, QoS, Dynamic Routing, Multi Constraint Routing, SSS.

I. INTRODUCTION

The mobile adhoc network is framed with set of nodes where each has the freedom to move on any direction and any speed. Such freedom makes the network topology to get change in each fraction and there is no fixed topology. Similarly, the limited transmission range of mobile nodes restricts them in communicating with the sink or destination node directly. To perform any data transmission, they involve in cooperative transmission. Each mobile node would perform transmission with the nodes falls within the transmission range. The source node generates route request to the sink node through the neighbor nodes. Once the routes are identified, a single route has been selected to complete the transmission. Each intermediate node involve in forwarding process to support the data transmission. However, there will be no constant node as neighbor and there will be higher frequency of link failure due to the mobility of intermediate nodes. Still, it is highly essential to maintain the streaming rate.

Route discovery and routing plays important role in achieving higher data rate. There are many routing strategies available to support data transmission. The shortest path routing is one among them, which select a least hop route towards data transmission. But when you consider only hop count, if there exist higher traffic or congestion then there will be higher latency and even the packet would be get dropped at any intermediate node. This increases the frequency of retransmission and increases the latency and reduces the throughput performance. So this increases the requirement of strategic techniques in routing the packets. Similarly, source routing has been identified as another option, where the source node selects a route according to some factors and the intermediate node has to follow the same. But the conditions of the network would get change in single fraction and by routing the packet with the same route would not support higher performance.

Dynamic routing is the process of routing packets according to the current conditions of the network dynamically. This eliminates the problem of source routing and should consider multiple parameters. When you route the packets according to a single factor like hop count, energy, congestion; the performance will not be achieved. To achieve higher performance in routing, it is necessary to include maximum factors in route selection. Towards this, a dynamic multi constraint routing algorithm is presented in this paper. Similarly, streaming support is the factor which represents the support of the route to achieve higher streaming performance. The modern applications requires higher data rate so that the service can be accessed successfully. For example, the mobile users watch different videos and audios through their devices. In this case, the data rate should be higher, so that the service will be accessed in success manner. This increases the requirement of considering streaming support in route selection process. All these issues encourage the design of dynamic routing protocol with multi constraint for improved performance in Manet. The working principle of proposed algorithm is presented in next sections.

II. RELATED WORKS

Different methods of routing protocol are discussed in literature and this section surveys set of methods among them towards the problem. In [1], the author presents an optimized multipath routing algorithm with network coding. The method considers the energy parameters of the nodes to utilize the energy in efficient way. It uses the balanced energy and network coding to perform multipath routing in Manet. In [2], the author presents a load balancing algorithm for multipath routing in manet. The method considered the need of load balancing in wireless network and to improve the performance of load balancing to distribute the traffic in global manner, an energy efficient load balancing algorithm which is incorporated with popular AOMDV algorithm to be named ELB-AOMDV.

Similarly, load balancing in multipath routing is presented to work based on the demand in [3]. The method monitors the traffic and according to the demand the load balancing is performed with the routing protocol AOMDV to be named as LBA-AOMDV. To improve the reliability in multipath routing in Manet an efficient algorithm is presented in [4]. The algorithm is designed to support data streaming in heterogeneous networks and performs multi hop routing to improve the quality of service of network. In [5], a token based routing algorithm is presented which enforces security and mufti hop cooperative routing using clustering algorithm. The path selection is performed using the cluster head identified. The cluster head is elected based on the trust value measured based on different factors like signal strength, traffic, mobility speed and energy depletion. In [6], a mobility based load balancing algorithm for multiple path routing is presented. The method considers the mobility feature of nodes in selection of route to improve the performance of QoS.

To reduce the retransmission frequency a disjoint multipath routing algorithm is presented in [7] which identify the routes which are spatially disjoint in maximum. The MSDM algorithm identifies the routes which are disjoint spatially which is enforced over the AOMDV algorithm. The method produces higher performance in routing. In [8], the author presents a multipath routing algorithm which considers the minimum power management towards the packet routing. The method uses the hops present, distance of transmission, receiving power to identify the routes. The EPAM algorithm works over AODV to produce noticeable results. In [9], the author present a trust based on demand algorithm for multipath routing has been presented. The AOTDV algorithm identifies the distinct routes where each route has hop count and trust value. Based on the hop count and trust values, the method performs route selection. In [10], the author presents a fuzzy based multi path routing algorithm. The method fabricates the fuzzy controller to reduce the frequency of reconstruction of Manet. The method identifies the routes based on the help of fuzzy controller.

A learning automata theory based routing algorithm is presented in [11]. The method uses the node stability model in measuring the weight for the node which represents the suitability of route to be elected. The method uses the learning automata theory to collect the feedback and based on that route has been selected. In [12], an probabilistic routing algorithm is presented which works on dynamic conditions. The method has been designed to reduce the number of duplicate packets by enforcing the probabilistic broadcasting algorithm which reduces the transmission of duplicate packets. The method computes the probability value for retransmission based on that the packet has been broadcasted by the intermediate nodes. In [13], a fitness based AOMDV algorithm is presented for the support of Manet. The method first discovers the routes and based on the energy constraint a optimal path has been selected using the fitness function and named as FF-AOMDV. In [14], a stable routing algorithm for Manet is presented which uses energy parameter and congestion. The method measure the stability of nodes and energy compatibility. The link stability has been measured based on which a stable route has been selected for data transmission. In [15], the author presents a Least Common Multiple based Routing (LCMR) towards the management of load. The method first identifies the paths and measures the latency on the routes. Based on the latency measured, the load distribution is performed. All the methods discussed above suffer to achieve higher performance in sink point streaming and introduces higher latency.

III. TECHNIQUE

Dynamic Multi Constraint Routing Technique: The proposed multi constraint routing algorithm generates the route request and broadcast to the neighbors. The neighbors receive the route request and verify the route table to find a route to the sink. Otherwise, the packet will be forwarded to the neighbors till a route has been identified. Using the routes identified, the method estimates streaming support score for each route. Based on the value of SSS, a single route has been selected to perform data transmission in Manet. The detailed approach is discussed in this section.

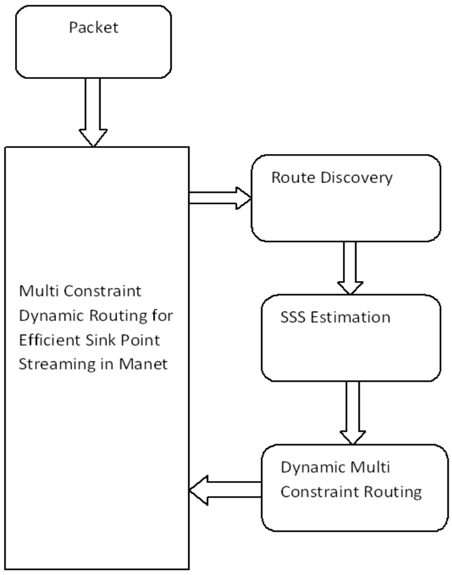

Figure 1: Architecture of Dynamic Multi Constraint Routing Scheme

The working architecture of proposed DMR routing algorithm is presented in Figure 1 and shows the architecture of proposed dynamic multi constraint routing scheme and shows various stages of the algorithm.

Route Discovery: The source mobile node generates a route request (DMR-RREQ) and broadcast the packet in the network. The neighbor nodes present around the transmission range receives the packet and verifies the presence of route to reach the sink node. If there is a route then it generates the reply to the source. Otherwise, the request has been transmitted to the neighbors. This will be iterated till a route to be identified and generates the route reply. The source node receives the route reply and extracts the list of routes available. Identified routes are updated to the route table. Discovered routes are used to perform data transmission in the network. Each node generates the route reply by tagging the energy conditions, traffic, number of neighbors, mobility speed and direction with the route reply. All these has been extracted from the route reply and added to the route table.

Algorithm:
Input: packet p, Neighbor Table NeT, Route Table RoT
Output: Null
Start
    Read packet p, NeT, RoT
    Generate route request DMR-RREQ = {SourceID,SinkID}
    Broadcast DMR-RREQ.
    Neighbor receives route request packet DMR-RREQ.
    If $\int_{i=1}^{size(RoT(Neighbor))} RT(i) \in Route \rightarrow Sink$ then
        Generate route reply DMR-RREP.
        DMR-RREP = {NodeID,Route,Source,Traffic,Energy,speed,direction}
        Send to source node.
    Else
        Add node id to request and forward to neighbors.
    End
    While true
        Receive route reply DMR-RREP.
        Extract route $R = \int Route \in DMRRREP$
        Add route to Route Table $RT = \sum(Routes \in RoT) \cup R$
    End
Stop

The route discovery algorithm presented explains how the routes towards the sink and source have been identified. Identified routes have been added to the route table to support data transmission.

Streaming Support Score Estimation: The streaming support score of any route represent the strength of route to support efficient data transmission towards sink point streaming. It has been measured according to the network conditions, node strategy and characteristic of the nodes. The network conditions like traffic at each hop and number of neighbors at each hop is considered. Similarly, the node strategy like mobility speed, direction, energy are used. Based on the above mentioned features, the method estimates hop strength measure, data support measure. Using the measures estimated, the method compute the streaming support score for any route. Estimated SSS value has been used to perform route selection towards data transmission.

Algorithm:
Input: Route R, Network Trace NeT, Route Table RoT.
Output: SSS
Start
Read route R and network trace NeT.
Collected traces of route Rt = $\int_{i=1}^{size(NeT)} \sum NeT(i).Route == R$
Compute hop support measure HSM.
HSM = $\frac{\sum_{i=1}^{size(R)} R(i).Mobility}{size(R)} \times \frac{\sum_{i=1}^{size(R)} R(i).Neighbors}{size(R)} \times \sum R(i).Direction \rightarrow sink$
Compute data support measure DSM.
DSM = $\frac{\sum_{i=1}^{size(R)} R(i).Energy}{size(R)} \times \frac{\sum_{i=1}^{size(R)} R(i).Traffic}{size(R)}$
Compute streaming support score SSS = HSM×DSM
Stop

The streaming support score algorithm presented above estimates the hop support measure and data support measure towards the estimation of streaming support score. Estimated streaming support score has been used to perform routing.

Dynamic Multi Constraint Routing: In this stage, the source node first discover the routes available towards the sink node. The route discovery is performed by broadcasting the route request packet and the route discovery results contains various information related to network condition and node strategy. Using these information, for each route identified, the method estimates the streaming support score (SSS). Based on the value of streaming support score of each route, a single route with higher value has been selected as forwarding route. The data packet has been forwarded through the route selected.

Algorithm:
Input: Packet P, Network Trace NeT, Route Table RoT, Neighbor Table Nt
Output: Null
Start
Update route table RoT = Route-Discovery(P)
For each route r
Estimate streaming support score SSS.
End
Choose route r with maximum SSS.
Forward data packet through route r selected.
Stop

The above discussed algorithm estimates the streaming support score for different routes identified and select a route with higher score to perform data transmission.

IV. RESULTS AND DISCUSSION

The proposed dynamic multi constraint routing algorithm has been implemented and evaluated for its efficiency under different parameters. The proposed algorithm has been implemented using network simulator NS2. The results obtained has been presented in this section and compared with the results of other methods.

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Table 1: Evaluation Details

Parameter name	Value
Number of nodes	200
Wireless protocol	802.11
Area	1000×1000
Simulation time	50secs
Transmit power	0.660W
Receiving power	0.395W
Initial energy	40J
Transmission range	50m
Constant bit rate	500kbps

The details of simulation and evaluation has been presented in Table 1, which is used to evaluate the performance of proposed dynamic multi constraint routing algorithm. The performance of the algorithm has been measured on different parameters. The packet delivery ratio is the measure which represent the efficiency of routing protocol in delivering the packet to the destination. It has been measured as follows:

$$PDR = \frac{\sum packets\ received\ at\ sink}{\sum packets\ sent\ from\ source}$$

Table 2 Evaluation of Packet Delivery Ratio

Number of Nodes	STMR in %	FF-AOMDV in %	SPSEG in %	DMR in %
10	5	8	12	32
20	13	15	19	38
30	21	24	28	45
40	27	32	38	52
50	32	37	43	60
60	41	42	46	70
70	45	48	54	82
80	48	53	59	87
90	53	57	63	92
100	56	65	78	96

The Table 2, present the result of packet delivery ratio produce by different algorithm under different number of nodes present in the network. The proposed DMR routing algorithm has produced higher packet delivery ratio than other methods.

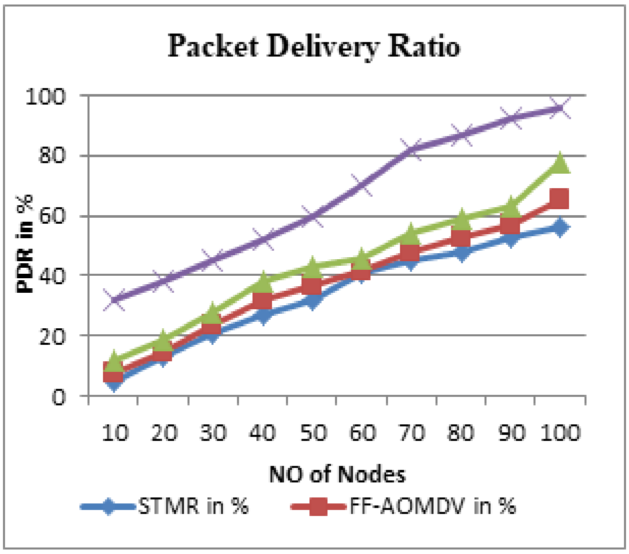

Figure 2: PDR vs No. of Nodes

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The performance on packet delivery ratio at different number of nodes has been acquitted and compared with other methods. The proposed DMR routing algorithm has produced higher packet delivery ratio than other methods. The routing overhead generated by different algorithm has been measured. It has been measured as follows:

Routing overhead = $\frac{\sum Traffic\ generated\ in\ routing}{total\ route\ discovery\ and\ routing\ perfomred}$

Table 3 Evaluation of routing overhead

Number of Nodes	STMR in %	FF-AOMDV in %	SPSEG in %	DMR in %
10	16	13	10	4
20	25	22	17	7
30	34	31	25	11
40	43	41	34	16
50	47	43	41	21
60	48	45	42	26
70	54	48	44	32
80	62	53	49	36
90	69	55	51	39
100	76	66	54	42

The overhead produced by the routing process has been measured under different conditions and compared between methods.

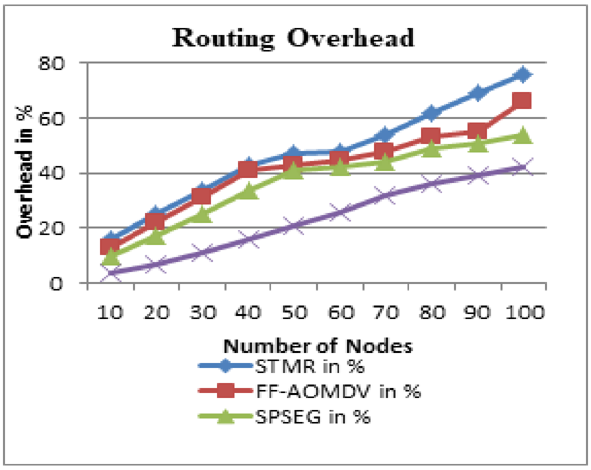

Figure 3: Performance on routing overhead

The routing overhead produced by different methods at varying number of nodes has been measured and presented in Figure 3. The proposed DMR algorithm has produced less overhead than others.

Table 4: Performance on latency

Number of Nodes	STMR in ms	FF-AOMDV in ms	SPSEG in ms	DMR in ms
1	1.6	1.3	1	0.4
2	2.5	2.2	1.7	0.7
3	3.4	3.1	2.5	1.2
4	4.3	4.1	3.4	1.6
5	4.7	4.3	4.1	1.9
6	5.8	4.5	4.2	2.3
7	6.4	5.8	4.4	2.6
8	7.2	6.3	4.9	2.9
9	8.9	7.5	5.1	3.2
10	9.6	8.6	6.4	3.6

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The latency of different algorithms are measured and presented in Table 4. The DMR approach minimize the latency compare to others.

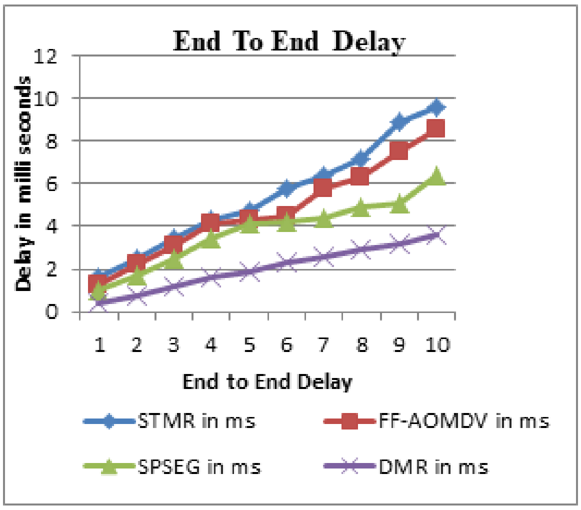

Figure 4: Performance on end to end delay

The latency introduced by different methods have been measured and presented in Figure 4. The proposed DMR algorithm has produced less latency than other algorithms.

Table 5: Performance on throughput

Number of Nodes	STMR in %	FF-AOMDV in %	SPSEG in %	DMR in %
10	12	15	18	23
20	21	25	29	35
30	28	32	34	41
40	31	35	39	47
50	34	36	43	53
60	35	37	47	60
70	37	38	55	65
80	42	44	62	73
90	44	46	70	79
100	47	51	81	87

The throughput performance obtained at different approach is measured and shown in Table 5. The DMR approach hikes throughput performance than others.

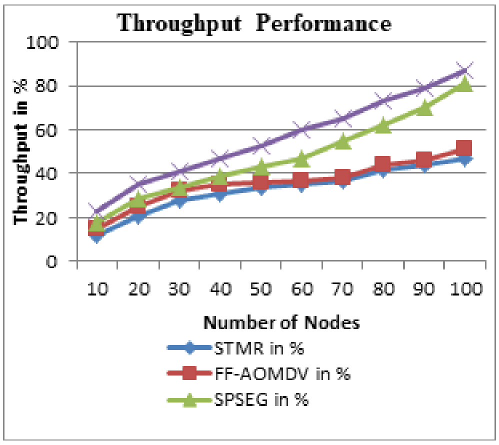

Figure 5: Performance on throughput

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The performance on throughput produced by different methods have obtained and compared. The DMR approach produces maximum throughput performance compare to other methods.

V.CONCLUSION

This paper presents the novel dynamic multi constraint routing for the improvement of sink streaming performance in manet. The meth identifies the list of routes available in the network. For each route, the method computes the hop support and data support measure. Based on the measures estimated, the method computes the streaming support score value for each route. Based on the value of SSs, a single route has been selected to forward the data packet. The proposed DMR algorithm has produced higher throughput performance and reduces the latency.

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