

## Performance /efficiency enhancement of Dynamic Source Routing Protocol in Wireless Mesh Networks

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### Abstract—

A Wireless Mesh Network is a collection of wireless nodes that form a network connection. There are several routing protocols like TORA, HEAT, AODV and DSR etc. which have been designed for providing communication among all the nodes in the wireless network. DSR is a reactive routing protocol and comfortable for unlimited number of nodes. This paper presents the comparison performance of DSR protocol with E-DSR (enhanced-DSR) protocol. In the enhanced approach of DSR, we improve the performance of Packet Delivery Ratio and throughput of the Wireless Mesh Networks. In E-DSR the destination a node recognizes first route request message (RREQ), it produces Turn-Around route request (TA-RREQ) message and deluges it to neighbor nodes within transmission range. E-DSR decreases route fail variation messages and gets very good performance as compared to Dynamic Source Routing protocol (DSR).

**Keywords—** WMNs, Packet Delivery Ratio, HEAT, E-DSR, RREQ (Route Request), RREP (Route Reply); Organization of the paper- The present paper has been organized into eight topics starting from the introduction of the Wireless Mesh Network and E-DSR. Topic second explains the literature review regarding Dynamic Source Routing. Topic third describes about the problem statement. Topic fourth tells us the overview of proposed enhanced-DSR (D-DSR), implementation work, working procedure of proposed enhanced-DSR algorithm, implementation code for E-DSR. Topic five depicts the experimental setup for simulation. Topic six describes about analyze the metrics based performance results for DSR and E-DSR. Topic seven describes the references. Topic eight concludes this paper. At last of this paper, there is description about the author.

### I. Introduction

Information Communication Techniques (ICT) has been broaden the usages and application as the introduction, networking becomes the backbone of the data communication 3G and 4G technology have made the networking with easy access. Wireless Mesh Network (WMN) is a wireless network in which several numbers of nodes are connected in a mesh topology. Wireless links connects all these nodes to each other in the network. Wireless Mesh Network has mainly the following components:

(i) Mesh clients (ii) Mesh Routers and (iii) Gateways. Laptops, mobile phones etc are the example of the mesh clients. The main functionality of mesh routers is to forward the traffic to and from the gateways. In a mesh network, each radio node is connected to all the radio nodes. Hence when a single node can't communicate or not in a working condition, the rest of nodes can communicate to each other. WMN is a self organizing, self healing wireless network. Nowadays, it is a popular technology because of low cost maintenance, ease of deployable etc. Routing is the important part of the communication on the Wireless Mesh Network. Several types of routing protocols are used in WMNs i.e. DSDV, HEAT scalable routing protocol, AODV, DSR etc. And different types of strategies are used in these protocols. However, there are several numbers of

routing protocols in WMNs, but regarding performance there is a need of enhancement in the performance of some routing protocols to maintain a fast responsive network.

In this paper, we proposed a new routing protocol enhanced DSR (E-DSR) which is the enhancement in the DSR routing protocol. In E-DSR, destination node uses turn-around RREQ to find source node. It reduces the number of route path fail alteration messages and therefore can enhance the performance of the network. Therefore, number of success rate of discovery route may be improved. The results of the simulation indicates our proposed enhanced algorithm improves the performance of DSR (Dynamic Source Routing) protocol in several types of metrics i.e. average end-to-end delay, average throughput etc.

### II. Literature Review

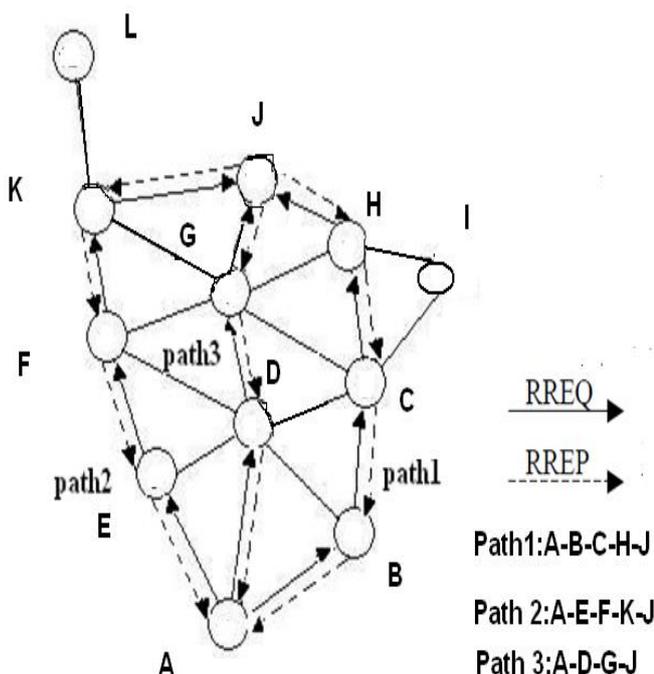
Dynamic Source Routing protocol (DSR) is a reactive, on-demand routing protocol, which finds the route as and when required, dynamically. DSR routing protocol manage the network without any centralized administrator or infrastructure. In route discovery this protocol discovers for the routes from source node to destination. In DSR, data packets stored the routing information of all intermediate nodes in its header to reach at a particular destination.

Routing information for every source node can be change at any time in the network and DSR updates it after each change occur [4]. Intermediate routers don't need to have routing information to route the passing traffic, but they save routing information for their future use. Basic purpose to develop DSR was to reduce the overhead on the network and designing self-organizing and self-configuring protocol to support WMNs. The DSR protocol contains two phases in its routing mechanism:

- a) Route discovery
- b) Route maintenance

**a) Route discovery:**

In the route discovery phase the source node establishes a route by flooding route request packets (RREQ). The RREQ contains the source IP address and destination IP address. The neighbor nodes accumulate the traversed path into the RREQ and broadcast to its next neighbor if the current node is not the destination node. Once the destination node receives the RREQ it concatenates the source route in a Route Reply packet (RREP) and replies on the same path as in RREQ. In the RREQ process, intermediate nodes update their routing tables to each of the nodes along the source route. In the route discovery phase each node uses route cache to store all multiple route entries to be maintained per destination. Fig.1 is an example of route discovery between source and destination nodes and possible discovered paths.



**b) Route maintenance:**

Route maintenance is carried whenever there is a broken link observed in the specific route to

the destination. When the packets are forwarded through a specific route, each node sends the packet to the next node in the route and the next node acknowledges the packet received. When a broken link is observed in the destination path the broken link will not acknowledge to the packet transmitted by the neighbor node, and the node send a route error message (RERR) to the source node. The source then responds to this RERR and stops sending the next packets and will look in its route cache for alternative routes and follow the next available path.

*DSR Features*

- The two most important features of DSR protocol are route discovery and route maintenance that make this protocol self-configuring and self-maintaining.
- In DSR protocol, there is no need of periodic updates to send over the network about neighbors or link state information. This reduces overhead on the network by eliminating the periodic updates send on the network. The both operations of DSR are on demand basis [4].
- A node may save more than one route for the same destination. In DSR it is carried out by listening to passing traffic, or by saving the additional routes when attempts for single route discovery. This property make DSR to use cache route in case of one route broke down, there is no need of route discovery as alternative routes are already available to the destination [4].
- Another important property of DSR routing protocol is network type flexibility. A packet using DSR routing protocol can reach its destination even when the intermediate nodes are using different type of network. DSR make it possible that nodes with different network types can participate in ad hoc networks, DSR protocol consider them as Ad hoc Network [4].
- There is unidirectional link support The basic algorithm for route discovery can be optimized in many ways [5].
- To avoid too many broadcasts, each route request could contain a counter. Every node rebroadcasts the request increments the counter by one. Knowing the maximum network diameter (take the number of nodes if nothing else is known), nodes can drop a request if the counter reaches this number.
- A node can cache path fragments from recent requests. These fragments can now be used to answer other route requests much faster (if they still reflect the topology!).
- A node can also update this cache from packet headers while forwarding other packets.

- If a node overhears transmissions from other nodes, it can also use this information for shortening routes.

Although dynamic source routing offers benefits compared to other algorithms by being much more bandwidth efficient, problems arise if the topology is highly dynamic and links are asymmetrical [5].

### III. Motivation of Work

DSR and most of the On-Demand Routing protocols in wireless networks, use solitary route along overturn path. If there is change in network topology frequently, then due to this reason the route reply could not get there to the source node i.e. when a node sends many of route requests; the node obtains a reply. Due to this reason, routing performance (like, long end-to-end delay, low packet delivery fraction and average throughput) is decreased. Therefore, how can we decrease the breakdown of RREP message?

### IV. Overview of proposed enhanced-DSR (E-DSR)

We propose the E-DSR to avoid RREP loss and enhance the routing in WMNs. E-DSR uses the method of RREQ of DSR to deliver route message to source node. We give the name to the route reply messages as TA-RREQ (turn around route request). E-DSR can respond from end to source if there is at least one path to source node. This describes how E-DSR put-off's a so many numbers of re-transmissions of RREQ (route request) messages and therefore eliminates the overcrowding in the wireless networks. Besides this, E-DSR will provide us the better performance of routing such as fraction packet delivery, end-to-end delay etc.

#### 1.1. Implementation

DSR and enhanced DSR are tested on MATLAB (also may be tested on NS-2 simulator) which is mostly used for research work regarding simulation purposes. MATLAB provides a support for simulation of routing protocols, wireless networks etc. MATLAB have many of the specialized features support for simulation of wireless networks.

#### 1.2. Working procedure of proposed Enhanced-DSR (E-DSR) Algorithm

A turn around route discovery procedure is used to discover the out routes on-demand. In E-DSR, the first route request message is received by the end node, after this TA-RREQ is generated and broadcasting of this message is done to neighbor nodes in a broadcasting range. When this TA-RREQ message is received by the source node, then source node starts the broadcasting process of packet, and rest of TA-RREQ messages are put aside for further use. When a transmitted TA-RREQ packet arrives to centre node, it will check for duplicity

communication. If it receives the same message, the dropping of message is done, otherwise message is forwarded. When a first turn-around RREQ is hold by the source node, then source node starts a packet distributing process. The RREQ message in E-DSR, have several fields such as IP address, request ID, end IP address, hop add up, request time etc.

In emergency condition such as route connection breakdown, transaction routes may be used. E-DSR decreases the number of failure alteration messages and obtains a excellence performance as compared to Dynamic Source Routing algorithm.

#### 1.3 Implementation code for proposed E-DSR protocol

```

recvTurnAroundRouteRequest(Packet *p) {
    struct hdr_ip *ih = HDR_IP(p);
    struct hdr_DSR_reply *rp = HDR_DSR_REPLY(p);
    char suppress_reply = 0;
    double delay = 0.0;
    aodv_rt_entry *rtc;
    #ifdef DEBUG
        fprintf(stderr, "%d - %s: received a RQREP'n", index,
            _FUNCTION_);
    #endif // DEBUG
    if (rp->rp_src == index) {
        #ifdef DEBUG
            fprintf(stderr, "%s: Got my own RQREP'n",
                _FUNCTION_);
        #endif // DEBUG
        Packet_free(p);
        return;
    }
    DSR_rt_entry *rt0; // it is reverse path
    rt0 = rtable_rt_lookup(rp->rp_src);
    if(rt0 == 0) {
        rt0 = rtable_rt_add(rp->rp_src);
    }

    rt0->rt_expire=CURRENT_TIME
    ACTIVE_ROUTE_TIMEOUT;
}

if (id_lookup(rp->rp_src, rp->rp_bcast_id)) {
    Packet_free(p);
    return;
}
id_insert(rp->rp_src, rp->rp_bcast_id);
ih->saddr() = index;
ih->daddr() = IP_BROADCAST;
rp->rp_hop_count += 1;
if (rt0) rp->rp_dst_seqno = max (rt0->rt_seqno, rp->rp_dst_seqno);
forward((DSR_rt_entry*) 0, p, NO_DELAY);
}
else {
    if ((rt0->rt_seqno < rp->rp_dst_seqno) ||
        ((rt0->rt_seqno == rp->rp_dst_seqno) &&
         (rt0->rt_hops > rp->rp_hop_count)) && (rt0->rt_nexthop == ih->saddr())) /* and from same source */ {
    }
}
    
```

```

#ifdef MDEBUG
fprintf(stderr, "Adding new router or updating existing
route: %i\n", rt0->rt_order);
#endif // DEBUG
rt0->rt_expire = max(rt0->rt_expire,
(CURRENT_TIME+REV_ROUTE_LIFE));
rt_update(rt0, rp->rp_dst_seqno, rp->rp_hop_count, h-
>saddr(), max(rt0->rt_expire, (CURRENT_TIME +
REV_ROUTE_LIFE)));
if (rt0->rt_req_timeout > 0.0) {
rt0->rt_req_cnt = 0;
rt0->rt_req_timeout = 0.0;
rt0->rt_req_last_ttl = rp->rp_hop_count;
rt0->rt_expire = CURRENT_TIME +
}}}}
    
```

**V. Experimental setup**

For the performance analysis of the routing protocol extensions, the experimental setup is done using Matlab R2010b. The simulation for the performance evaluation may be done using NS-2.34 network simulator. Research has been taken out for the evaluation performance of the routing protocols in Wireless Mesh Networks. The main goal is to reduce the end-to-end delay and improve the PDF and throughput. The same parameters are used here for the simulation of both routing protocols i.e. DSR and E-DSR. The following parameters are set for the simulation purposes as shown in table 1.

Table 1: Mesh topology simulation parameters

Parameter	Value
Number of Nodes	100
Packet Size	127 bytes
Data Rate	100k
Operational Frequency	2.4 GHz
Simulation Time	600 sec
Pause Time	0s, 20s, 40s, 60s, 80s
Topology Used	Mesh Topology
Mobility Strategy	Random Way Point
Transmission Radius of each node	20 m
Type of traffic	CBR
Domain	100m*100m*100m
Max Speed	10,20,30,40,50,60 m/s
Burst Time	200 m/s
Random Noise	0

**Analyze the metrics based performance results for DSR and E-DSR**

Here, results are shown for performance of DSR routing protocol and E-DSR routing protocol. We analyze then using the metrics:

*EED (end-to-end delay)*: refers to that the time taken for a packet to be transmitted across a network from source to destination.

*PDF (packet delivery fraction)*: the ratio of the number of delivered data packet to the destination.

This illustrates the level of delivered data to the destination.

$$\frac{\sum \text{Number of packet receive}}{\sum \text{Number of packet send}}$$

The greater value of packet delivery ratio means the better performance of the protocol.

*Average throughput*: throughput or network throughput is the average rate of successful message delivery over a communication channel. It is expressed in kilobits per second.

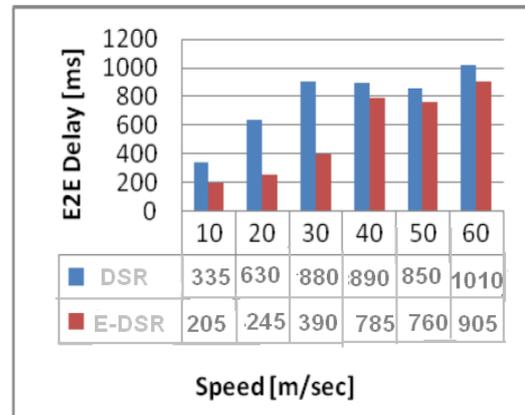


Fig 2: Mobility Vs End to End Delay

Fig 2 indicates the average EED of DSR and E-DSR protocols. Here, delay has to be supposed for the packets that actually arrive at the destinations. We analyze that delay of E-DSR is lower as compared to DSR. E-DSR chooses route earlier.

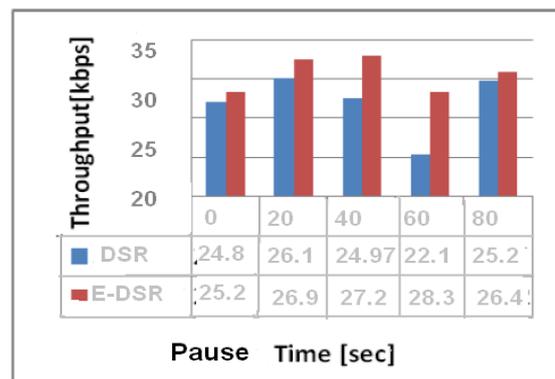


Fig 3: Pause Time Vs Packet Delivery Fraction

Fig 3 represents the result of Pause Time Vs Packet Delivery Fraction. This result indicates the rate of packet drop. It describes packet deliver ratio of DSR and E-DSR, by improving in the pause time. The EED (end-to-end delay) includes the processing time and queuing time.

For excellent performance, End-to- End Delay must be low.

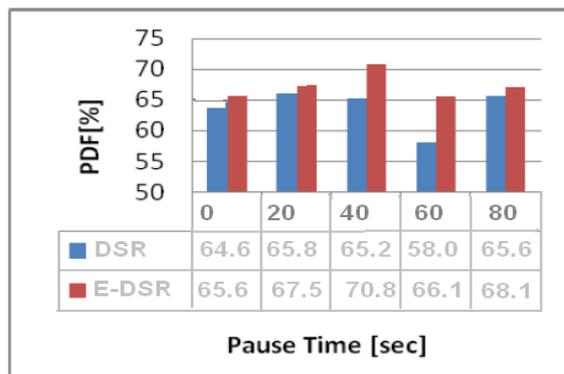


Fig 4: Pause Time Vs Average Throughput

Fig 4 describes that, after increasing the pause time, performance result of E-DSR produces well as compared to existing DSR routing protocol.

## VI. Conclusion

The routing in Wireless Mesh Network is the main part of communication. Several types of routing protocols are used in WMNs. To enhance the overall performance of the WMNs, improvement in the routing protocol is need of time. In Dynamic Source Routing protocol, RREP messages are very important for WMNs for send messages. A degradation of performance takes place due to the high rate of route reply. And if route reply takes place high, there is chances of route reply lost. Route reply mechanism will be affected. In this paper, it is proposed the idea of enhanced DSR, which attends TA-RREQ. E-DSR route detection succeeds in a smaller amount tries than DSR. We have attempted a simulation to analyze the performance of E-DSR with that of DSR using MAT Lab. The results indicate that E-DSR enhances the performance of DSR in several metrics, as the packet delivery, ETE delay. In future, we will analyze the performance of DSR and E-DSR routing protocols on the behalf of another metrics. We will test this proposed algorithm in other routing protocols such as AODV routing protocol.

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**Er. Pushpender** received the B.tech degree in Information Technology Engineering and M.Tech degree in Computer Science and Engineering from M.D. University, Rohtak (India). He has been in teaching profession more than three years. Beside he has the good industrial exposure in the field of computer technology and network. He is a research scholar pursuing his Ph.D from Shri Venkateshwara University, Gajraula (UP), India in Wireless Mesh Networks specializing Routing Protocols.

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