Implementation and Performance Evolution of ADSR Routing Protocol for MANET

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ABSTRACT - The Proposed routing algorithm Ameliorated Dynamic Source Routing protocol (ADSR) is a modified DSR protocol with improved performance for Mobile Ad hoc Network (MANET). Aim of this algorithm is to overcome the disadvantages in conventional DSR Protocol: Energy constrains, congestions and route reply storm problem. ADSR adjusts the Round Trip Time and limits the RREP message count from destination to control route reply storm and congestion. It also saves the energy consumed by nodes during data communication by using Discontinuous Reception (DRX) method. All three protocols original DSR, existing system Efficient Power Aware Routing (EPAR) algorithm and proposed system ADSR are evaluated and performance comparison has been done to show the improvements in ADSR. Simulations are performed using NS-2 by considering various network metrics.

Keywords: Dynamic Source Routing Protocol (DSR), Round Trip Time (RTT), Route request, Route reply, Short DRX, Long DRX, Route discovery, Route maintenance.

1. INTRODUCTION

A Mobile Ad-hoc Network is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas others need the aid of intermediate nodes to route their packets. All nodes in MANET are battery operated. These networks are fully distributed, and can work at any place without the help of any fixed infrastructure as access points or base stations. Mobile Ad-Hoc Network routing protocols are commonly divided into three main classes; proactive, reactive and hybrid protocols.

DSR is a reactive protocol. It is also known as source routing protocol as the source node adds the whole route up to the destination node to the packets header. DSR is based on the two basic mechanisms namely Route Discovery and Route Maintenance. During the route discovery a route is set up on-demand. The route maintenance monitors an established connection during a communication between nodes. DSR is able to operate on networks containing unidirectional links but it works optimal in a network with bidirectional links.

Disadvantages of DSR protocol: Packet header size grows with route length due to source routing. Flood of route requests may potentially reach all nodes in the network. Care must be taken to avoid collisions between route requests propagated by neighboring nodes like insertion of random delays before forwarding RREQ. The route maintenance mechanism does not locally repair a broken link. Source will transmit the RREQ messages to all the neighboring nodes to find the route to destination. It is fair and good when there are few nodes in the network, it will easily find a route and it can receive a RREP message from the desired destination. But if in case the network size is very high and participating nodes are numerous, then there will be a possibility to have so many routes to the destination. It may result in the reply storms this may cause collision of packets and it may increase the congestion at the nodes while sending reply. An intermediate node may send Route Reply using a stale cached route, thus polluting other caches. This problem can be eased if some mechanism to purge (potentially) invalid cached routes is incorporated.

2. EXISTING SYSTEM

Efficient Power Aware Routing algorithm [1] is a new protocol that increases the network lifetime of MANET. EPAR follows the same process of sending RREQ and receiving RREP for route discovery process as in DSR. Only difference is when choosing a path, the DSR implementation chooses the path with the minimum number of hops but in EPAR the path is chosen based on energy.

In this routing algorithm first the battery power for each path, that is, the lowest hop energy of the path is calculated. The path is then selected by choosing the path with the maximum lowest hop energy using the formula.

$$\underset{k}{\mathrm{Max}}\ T_k(t) = \underset{i \in k}{\mathrm{Min}}\ T_i(t)$$

where, Tk(t) = lifetime of path , Ti(t) = predicted lifetime of node i in path k.

The energy consumed for one packet is calculated by the equation

$$Ec = \sum_{i=1}^{k} T(ni, ni+1)$$

Where ni to nk are nodes in the route while T denotes the energy consumed in transmitting and receiving a packet over one hop.

Data packet format is modified in EPAR as shown below.

IP Header	DSR fixed Header	DSR Source Header	DSR Source Route Address	EPAR Source Route MTP [1…N]	Link Flag	DATA

Fig 1 Data packet format of EPAR

If for any reason a node chooses to change the transmit power for a hop i, then it must set the new transmit power value in minimum transmission power (**MTP[i]**) to the actual transmit power. If the new power differs by more than $\mathbf{M}_{\mathbf{thresh}}$ then the Link Flag is set.

The existing system mainly deals with the problem of maximizing the network lifetime of a MANET, i.e. the time period during which the network is fully working. EPAR is basically an improvement on DSR. Author of this system has evaluated three power-aware ad-hoc routing protocols in different network environment taking into consideration network lifetime and packet delivery ratio. Overall, the findings show that the energy consumption and throughput in small size networks did not reveal any signicant differences. However, for medium and large ad-hoc networks the DSR performance proved to be ineffcient in the study. In particular, the performance of EPAR and DSR in small size networks was comparable. But in medium and large size networks, the EPAR produced good results and the performance of EPAR in terms of throughput is good in all the scenarios that have been investigated.

3. PROPOSED SYSTEM

Ameliorated Dynamic Source Routing (ADSR) protocol is a modified DSR protocol for Mobile Ad-hoc Network. Purpose of this routing protocol is to control the congestion in the network and reduce the route reply storm, by which the throughput of the network gets improved. This routing protocol also reduced the energy/power consumed by the nodes participating in the data transmission between source node and destination node

Discontinuous reception (DRX) a method used in this algorithm to conserve the battery of the mobile nodes. This is a function designed into the protocol that allows this to happen - most notably how the transmission is structured - for example in slots with headers containing address details so that devices can listen to these headers in each slot to decide whether the transmission is relevant to them or not. In this case, the receiver only has to be active at the beginning of each slot to receive the header, conserving battery life.

Round Trip Time is the time required for a single packet to travel from a specific source to destination and back again. Window Size is the number of data packets that can be sent without waiting for an acknowledgement.

Window Size = Throughput * RTT

Throughput = Window Size / RTT

DSR uses RREQ packets to find out a source route for a packet. It receives the RREP packets from the destination which has the info about the nodes a packet has to go through and the number of hops. Here DSR is modified to calculate the round-trip time taken by the RREQ packet. The information about the number of hops and round-trip time measured at DSR is passed to TCP. With this information, different estimates of RTO are maintained for different number of hops. Since hop based information for timer estimation is incorporated in this protocol it can be called as HTCP. At the start of the connection, or for the first measurement for that hop, srtt for that entry is taken as time difference between sending of RREQ packet and arrival of RREP packet of DSR and rttvar as srtt/2. As the connection progresses, different sets of values for srtt, rttvar and RTO are maintained for different routes. If there is a route change due to route failure, DSR informs that to the TCP sender. DSR comes to know about it through RERR messages it gets from the network.

Retransmission is a problem both from the network perspective where contention increases and sender perspective where it leads to incorrect updates of RTO. Hence preventing re-transmissions do well to improving performance. The gain obtained by this approach is three fold.

1. Maintaining different values of RTO for different routes prevents the problem of random variations in RTO estimations which could result from frequently varying routes and frequent route failures. This helps in better estimates for that specific route or the route using particular number of hops.

2. In standard TCP no value of srtt is assigned at the start of the connection. In our approach we obtain this value from DSR. Since we take rttvar as srtt/2, variations in this value are accommodated. This leads to faster convergence to true value of RTO.

3. Informing TCP sender about ROUTE-FAILURE helps in preventing false/spurious transmissions.

The RTO information is maintained in the form of the following table.

No. of	1	2	…	N

Hops				
Srtt	Srtt(1)	Srtt(2)	…	Srtt(N)
Rttvar	Rttvar(1)	Rttvar(2)	…	Rttvar(N)

Table 1 Timer estimate for Different Hops

The corresponding values of srtt(i) and rttvar(i) are picked up and used for rto computation for a packet with that particular number of hops. Its current measurement of rtt is used to learn new values of srtt and rttvar for each hop. Simulation results show that the scheme enables faster convergence to true value of RTO. Average delay and number of re transmissions is reduced as the number of hops increases. This helps in increasing the throughput.

Limit on the Replies from Destination: In the original implementation of DSR, a destination node replies to every route request packet that it hears. This, however, results in a lot of unnecessary route replies when the same route request is heard by a destination multiple times. This can also result in 'bad' routes being added to the route cache of the source.

Hence DSR can be modified such that destination nodes will reply only if

a) The last route request from the given source was older than the current one, or

b) The last route request was made at the same time (the same route request took different routes to the destination) but the current request took fewer hops than the last one.

c) A destination node sends reply for four RREQ messages received with same request ID. This helps to reduce route reply storm problem.

The destination now sends a route reply only if it is a new route request or a better route for a route request to which it has already replied.

4. SIMULATION RESULTS AND PERFORMANCE COMPARISON

Simulation setup:

Table 2 lists the simulation parameters in detail.

Number of Nodes	100
Area size	2000 × 2000
Traffic type/ Data type	CBR
Channel capacity	1.5Mbps
Data Rate	1Mbps, 0.5Mbps
Transmit power	0.6J
Receive power	0.3J
Idle power	0.1J
Sense power	0.05J
Initial energy	20J
Simulation Time	30s
Communication system	MAC/802.11
Transport layer protocol	TCP, UDP
Network layer protocol	ADSR, DSR, EPAR

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Table 2 Simulation Setup

Simulation Results:

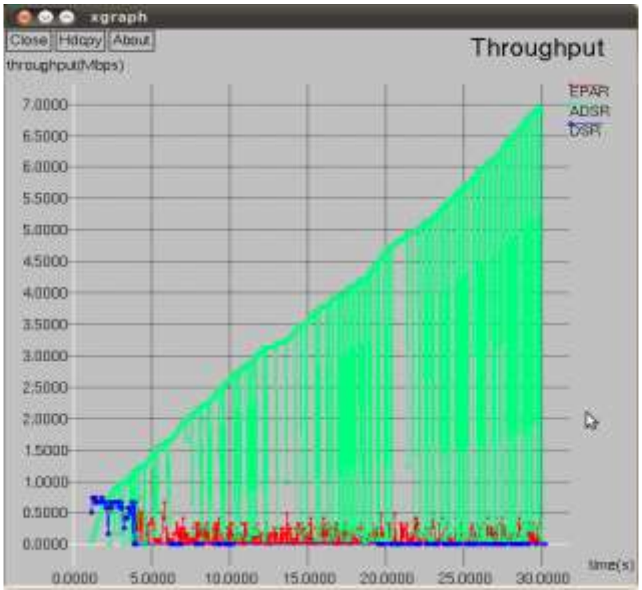

Fig 2 Throughput of DSR, EPAR & ADSR

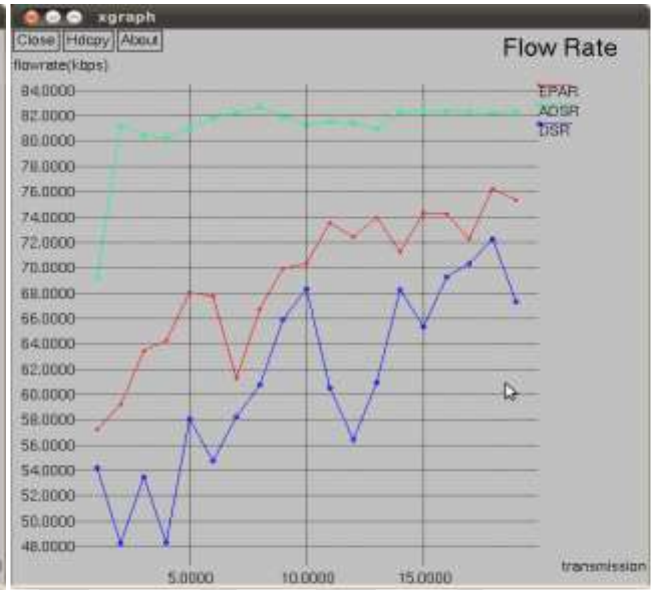

Fig 3 Flow rate of DSR, EPAR & ADSR

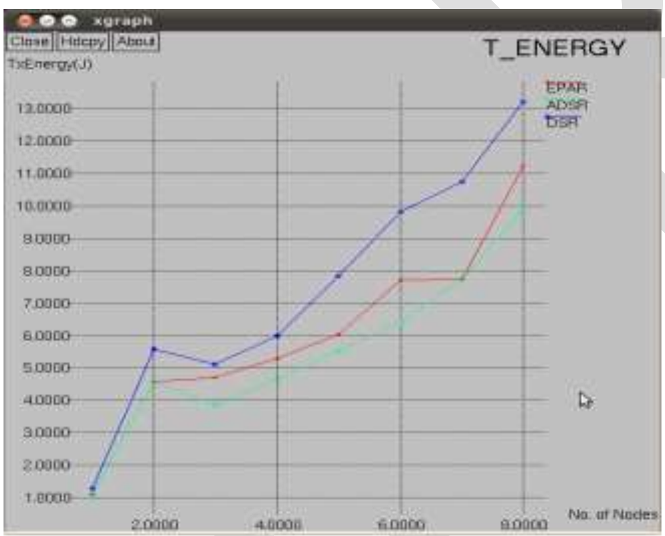

Fig 4 Txn Energy of DSR, EPAR & ADSR

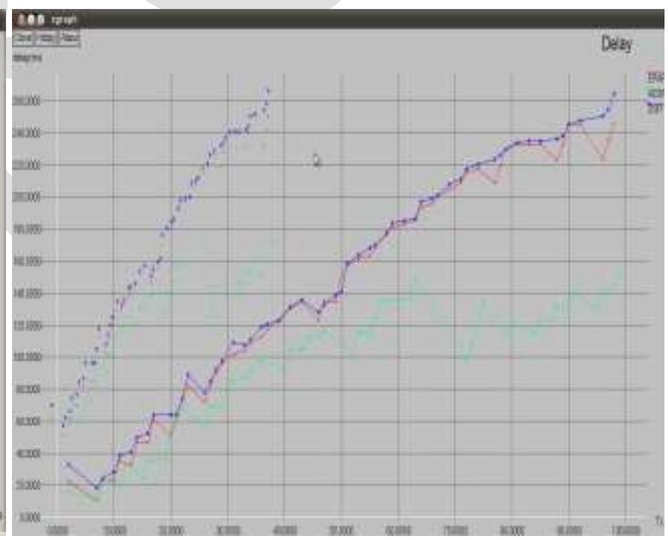

Fig 5 Delay of DSR, EPAR & ADSR

From above graphs we can see that ADSR performs better than conventional DSR and EPAR routing protocols. ADSR provides good throughput as congestion is reduced in the network. End-to-End delay of the network has been reduced by ADSR when compared to other two protocols. Energy consumption during data transmission is less in ADSR. Flow rate is finally maintained to stable as energy retention in the network nodes are retained at good level for data transmission by saving energy usage.

Packet Delivery Ratio:

Parameters	Results for DSR	Results for EPAR	Results for ADSR
RREQ sent	1953 bytes	2109 bytes	916 bytes
RREP received	11298 bytes	14874 bytes	12296 bytes
Data sent	1167 bytes	2562 bytes	3828 bytes
Data received	635 bytes	1569 bytes	3720 bytes
Router drop	5	9	3
Delivery Ratio	52.17%	61.20%	97.17%

Table 3 Comparison of Packet Delivery Ratio between DSR, EPAR and ADSR

Average values of measurement parameters

Parameters	DSR	EPAR	ADSR
Throughput	0.163702 Mbps	0.157209 Mbps	2.476804 Mbps
Transmission Energy	7.44 J	6.04 J	5.47 J
Flow rate	61.09 Kbps	69.04 Kbps	81.12 kbps
Delay	148.39 ms	144.06 ms	96.01 ms

Table 4 Average values of measurement parameters

5. CONCLUTION

Energy saving is an important optimization objective in MANET, the energy consumed during communication is more dominant than the energy consumed during processing because of Limited storage capacity, Communication ability, computing ability and the limited battery. ADSR has reduced route reply storm problem by adjusting RTT and setting limit on the replies from destination. Thus ADSR has achieved better throughput. ADSR also saves the energy during data transmission by using Discontinuous Reception method. From the performance evaluations done for the Amelioration Dynamic Source Routing protocol by comparing with DSR and EPAR, we can say that ADSR outperforms DSR and EPAR by 40% and 30% respectively. By observing the impact of energy constraints on nodes in physical layer and application layer of the networks ADSR offers the best combination of energy consumption and throughput performance. ADSR gives better throughput, packet delivery fraction, transmission energy and delay performance compared to DSR and EPAR.

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