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PARURP: Power Aware and Route Utility function based Routing Algorithm for Mobile Ad hoc Networks

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Abstract

Transmission of real time (In elastic) and non real time (elastic) data transmission in Mobile ad hoc network (MANET) is still undergone a emerging research area due to the limited energy and resources of the nodes in the network. This paper proposes the Aware and Route Utility function based on routing algorithm (PARURP) for admitting the data transmission onto an optimum path. Sink choose the optimum path dynamically based on the Route Utility (RU) function of the nodes in the various path and to send the route reply among the selected path. It provides Enhanced service quality of data without affecting the delay and energy tradeoff. The performance of the PARURP evaluated through NS2 simulation. It results shown that the PARURP is yielding better performance metrics compared to the previously stated algorithm in terms of energy utilization, delay and throughput.

Keywords: *MANET, Energy efficient, QoS, Routing, DSR.*

1. Introduction

Ad Hoc Network is a multi-hop wireless networks which consist of autonomous mobile nodes interconnected by means of wireless Medium without having any fixed infrastructure. It's quick and easy deployment in a situation where it's highly impossible to set up any fixed infrastructure networks, has increased the potential use in different applications in different critical scenarios. Such as battle fields, emergency disaster relief, conference and etc. Generally the MANET can be composed by the mobile nodes, which were move to any direction. Due to its ad-hoc in nature, it has no base station or any central access points. All the nodes in the network are self- configuring, self-maintaining and self organizing themselves by means of radio links. Every node's in the network act as routers and centralized servers. In order to transfer the data packets from the source to destination, all the nodes are incorporated with the routing mechanism. All the nodes in the network are having limited resource constraint, hence severely affected by the continuous operation. If the transmission of data packets needs to be change due to the node's mobility, then route discovery procedure has been called. The energy utilization of the nodes is increased due the above said process and decrease the life time of the nodes in the network. Various routing methodologies have been proposed to reduce the power consumption caused by different terminologies in the MANET, which in result not only prolongs the life time of individual nodes but also reduces the network partition and enhances the performance of the network.The network is considered as a temporary network as it is meant for a specific purpose and of a certain periods of time. And it is based on multi-hop technology where the data can be transmitted through number of intermediate nodes form source of destination. With the rapid demands of MANET in the recent years, certainly have challenged the researchers to take up some of the crucial issues like bandwidth utilization, limited wireless transmission range, hidden terminal and exposed terminal problem, packet loss due to transmission error, mobility, stimulated change of route, security problem and battery constraint [2][3].

One of the important challenges of MANET is power constraint. The mobile ad hoc networks are operated on battery power. And the power usually gets consumed in mainly two ways. First one is due to transmitting of data to a desired recipient and secondly, the mobile node might offer itself as an intermediate forwarding node in the networks[4][5]. The power level of the node is also getting affected while any route is established between two end points. The trade off between frequencies of route updates dissemination and battery power utilization is one of the major design issues of ad hoc network protocols[8][9]. Because high power consumption will increase the battery depletion rate which is in turn reduces the node's lie time, network lie time and causes network partition. Due to high network partition performance affected due to increase in

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number of retransmission, packet loss, higher end to end delay and many more problems[7].
Therefore, various energy efficient routing protocols have been proposed to increase the lifetime of the nodes as well as lifetime of the networks, so that communication can be carried out without any interruption[10][13]. This article provides as well as analyses different energy efficient routing protocols designed for ad hoc wireless networks which are only based on the mechanism of traditional DSR routing protocol.
Further this paper structured as follows, section 2 describes the related power consumption algorithms, section 3 presents the proposed routing protocol model, Section 4 illustrates the performance evaluation with results and finally concluded in section 5.
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2. Related Works

G. Vara prasad [12] proposed a new routing algorithm for the mobile ad hoc networks to route the data packets to the destination based on the residual battery capacity and signal strength. The proposed model has simulated with the help of network simulator and has compared to the algorithms namely, MTPR and CMMBCR. The simulation results are shown that the proposed model has reached top position in terms of the network lifetime, network throughput and percentage of path reconstructions as compared to MTPR and CMMBCR models.

Fuad Alnajjar [1] proposed a cross layer design to attain a reliable data transmission in MANET. In MANET environment challenge is to design a mechanism that can provide high quality of service with a high level of performance or to achieve service quality in terms of high delivery rate, low latency and low bit error. The key components of the approach include a cross-layer design (CLD) to improve information sharing between network and physical layers. They present a model that allows the network layer to adjust its routing protocol dynamically based on signal noise ratio (SNR) and received power (RP) along the end-to-end routing path for each transmission link to improve the end-to-end routing performance in MANET.

A.Valarmathi and RM.Chandrasekaran [11] proposed the original DSR protocol is modified to define the occurrence of congestion by monitoring and reporting multiple resource utilization thresholds as QoS attributes and use multi-path-routing and load-balancing during the periods of congestion to improve QoS in MANETs for CBR multimedia applications. NS-2 simulation was extensively carried out to evaluate the performance of the modified DSR in terms of throughput, jitter and end-to-end delay.

M. Pushpalatha, et al., [6] proposed a trust based energy aware routing model in MANET. During route discovery, node with more trust and maximum energy capacity is selected as a router based on a parameter called 'Reliability'. Route request from the source is accepted by a node only if its reliability is high; otherwise, the route request is discarded. This approach forms a reliable route from source to destination thus increasing network life time, improving energy utilization and decreasing number of packet loss during transmission.

3. Route Utility function based Routing Algorithm

A node says X want to send the data to the sink, it broadcasts the R_Req packet towards the sink by using multi hop nature. The R_Req packet traverses across various path of the network. If any intermediate node having the information about the sink it just select the next hop towards the intended receiver. Finally more number of R_Req packets reached the sink across different path. After getting the R_Req's by the sink, it decides which one is the best possible path for sending R_Req packet. For selecting the energy aware path, we are using additional bit in the R_Req packet about the service of the data whether the data packet is elastic or in elastic. Upon receiving the R_Req packet the intended transmitter reserve the network resources for near future data transmissions. Figure 1 show that the R_Req packet format for DSR protocol.

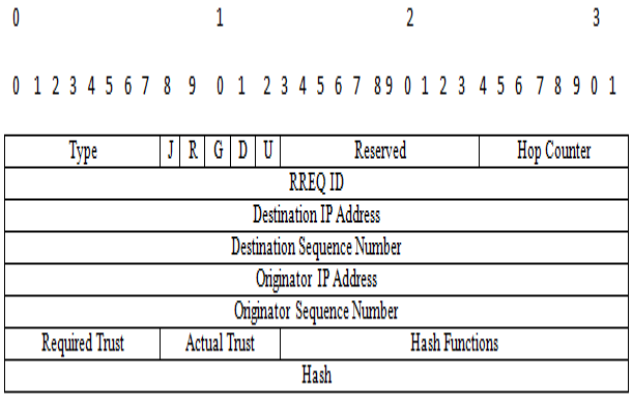

Fig.1 Standard Route request packet format of DSR

The figure 2 shows a network contains more than one path for R_Req packet from source to sink. For our computing

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convenience we take 3 numbers of paths say, X, Y and Z clears in the figure.

3.1. Route Utility Function (RU)

The Route Utility Function (RU) can be calculated by using the SNR value of the individual nodes in the various paths towards the sink and respective hop counts.

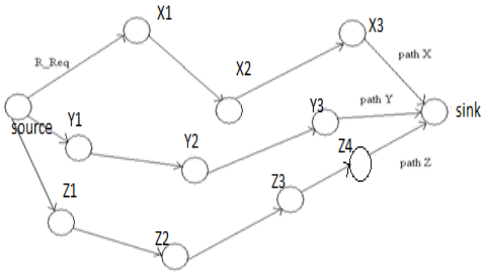

Fig.2 Traverse path for R_Req packet in the network

Let, SNR value of the individual node on the path: SNR_I
Where I is one of the nodes in the path to sink: I Ɛ Ns and N is the total number of nodes in the path.

SNR value of the path:

$$SNR_p = \sum SNR_I \prod (N-1) \quad (1)$$

Route cost of the path:

$$Rc = \text{Max } \{SNRp\} \quad (2)$$

For real time in elastic data transmission the number of nodes in the path is low as possible because of reducing the end to end delay.
Number of hop count already available in the R-Req packet. It will be denoted by H_c.

The minimum Hop count (HC_{min}) of the particular path will be calculated by,

$$HC_{min} = \text{Min } \{X_i, Y_i, Z_i\} \quad (3)$$

Where i = 1 to N.
The Route Utility function (RU) can be obtained from the table 1.

Table 1: Route Utility function

RU =

HC_{min}	Rc
High	High
High	Low
Low	High
Low	Low

The path C_{min} = low and Rc = High is selected for further transmission by RU.

4. Results and Discussions

The proposed algorithm is evaluated using NS2 event driven simulator, and the performance metrics of the PARUP compared with the Dynamic source routing protocol under varying the number of nodes in the network. Figure 3 and 6 shows that the PARUP achieves high throughput and packet delivery ratio compared to the existing DSR routing protocol. Figure 4 and 5 clears that the proposed approach minimizes the average energy utilization and delay compared to the existing stated. However the routing protocol enhances energy utilization and it is slightly increases the control overheads for transmitting the control packets.

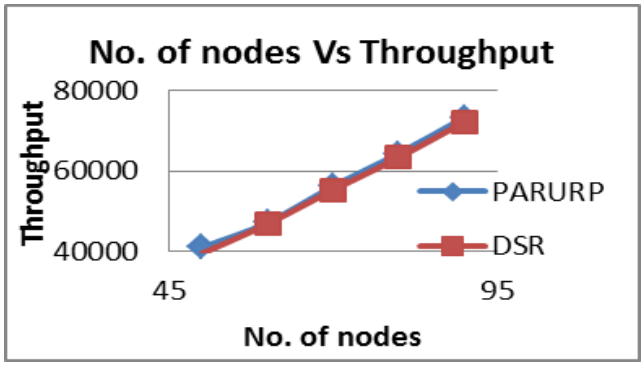

Fig.3 No. of nodes Vs Throughput

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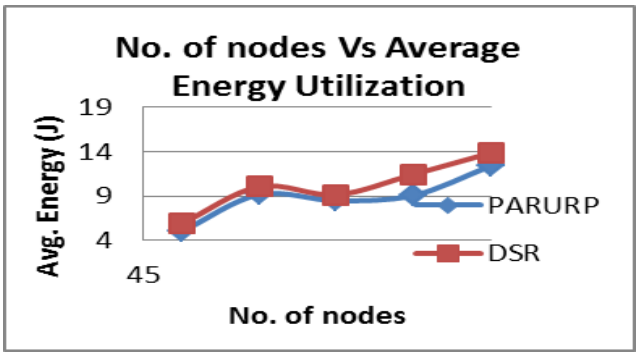

Fig.4 No. of nodes Vs Average Energy Utilization

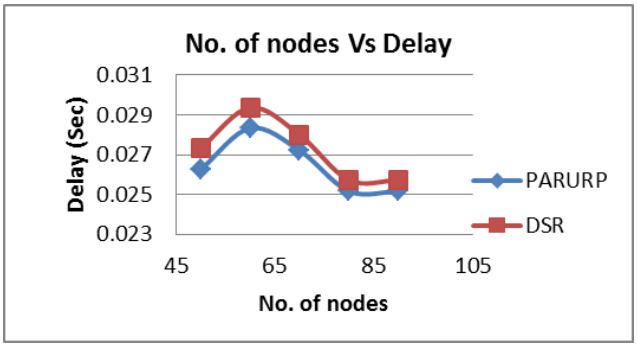

Fig.5 No. of nodes Vs Delay

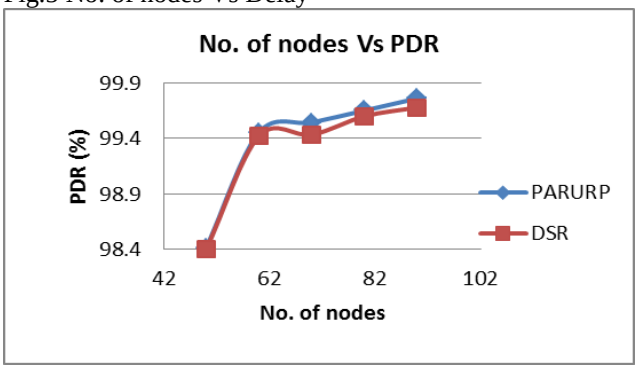

Fig.6 No. of nodes Vs Packet Delivery Ratios

5. Conclusions

In this paper, Sink chooses the optimum path dynamically based on the Route Utility (RU) function of the nodes in the various paths and to send the route reply among the selected path. It provides Enhanced energy utilization without comprising the service quality of data. The performance of the PARURP is analyzed through event driven simulator. Simulation results shown that the PARURP provides better performance metrics compared to the existing stated algorithm in terms of energy utilization, delay and throughput.

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