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Power Efficient MANET

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***Abstract*: The latest advancement of wireless technology and its applications plays a vital role in today's scenario. An ad hoc network is one such recent technology, which gives a new paradigm for wireless self-organized networks. Ad hoc networks are simple peer-to- peer networks, self-organized and with no fixed infrastructure. They are used in military oriented tactical operations, for emergency law enforcement, and in rescue missions and in various other applications. We have proposed On Demand Based Energy Efficient Routing Protocol (ODBEERP). The main aim of proposed protocol is to discover the minimum power-limitation route. The power limitation of a route is decided by the node which has the minimum energy in that route. So compared with the minimum node energy in any other route, the minimum node energy in the minimum power-limitation route has more energy. We have also proposed a more accurate analysis to track the energy consumptions due to various factors, and improve the performance during path discovery and in mobility scenarios. The proposed protocol is evaluated with object oriented discrete event simulator environment. Simulation results shows that the ODBEERP achieves good throughput, less delay, high packet delivery ratio and good energy efficiency than the existing protocol PEER.**

Keywords- MANET, Packet Delivery Ratio, Energy Efficiency, throughput and delay, ODBEER

INTRODUCTION

A Mobile Ad hoc Network (MANET) is a collection of self configurable mobile node connected through wireless links. In MANET nodes which are within the range of each other can connect directly where as nodes which are not in the vicinity of each other rely on the intermediate node for communication. Some special characteristics of MANET like dynamic topology, fast deployment, robustness make this technology an interesting research area. Each node in MANET can work as a sender, receiver as well as router. Communication in the network depends upon the trust on each other. Communication can work properly if each node co-operate for data transmission.

The following algorithm depicts the communication in any ad hoc network:

1. Sender node sends the signal to the neighbouring nodes within the vicinity.
2. Neighbouring nodes communicate with the sender node
3. Sender node sends the message to the destination node.
4. If destination node is within the vicinity then message received by the destination node else an intermediate node receives the message.
5. Restart the process of forwarding the message from step no 1 till the destination node is reached.

Confidentiality, integrity, availability, non-repudiation and authentication are the basic requirements of information security. Ad hoc network's dynamic topology with no centralized administration makes it highly vulnerable for its security-breach. Particularly secure routing in ad hoc networks has been a challenging task for researchers.

EXISTING SYSTEM

For conserving energy, many energy-efficient routing protocols have been proposed. These protocols can be generally classified into two categories: Minimum Energy routing protocols and Maximum Network Lifetime routing protocols. Minimum Energy routing protocols search for the most energy-efficient path from the source to the destination, while Maximum Network Lifetime routing protocols attempt to balance the remaining battery-power at each node when searching for the energy-efficient path. Since Minimum Energy routing scheme is also an important part in most recent Maximum Network Lifetime routing protocols such as Conditional Max-Min Battery Capacity Routing (CMMBCR) and Conditional Maximum Residual Packet Capacity (CMRPC) routing, we will focus on developing more efficient Minimum Energy routing protocols in this research work. Li and Wan described a distributed protocol to construct a minimum power topology and develop an algorithm which directly find a path whose length is within a constant factor of the shortest path. The length of the path is measured in term of energy consumption. This proposed algorithm used only local information.

A topology based on minimum spanning tree, called localized minimum spanning tree (LMST) was proposed by Li et al. It is a localized distributed protocol with the following properties:

(1) the protocol generates a strongly connected communication graph;
(2) the degree of any node is at most six, and
(3) the topology can be made symmetric by removing asymmetric links without impairing connectivity.

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An energy efficient dynamic path is maintained to send data from source to destination for MANET is proposed in Sheu, Tu, and Hsu. Due to mobility existing paths may not be energy efficient. So, each node in a data path dynamically updates the path by adjusting its transmission power. Each node in the networks determines its power for data transmission and control packets transmission according to the received beacon messages from its neighbors. In dynamic path optimization technique protocols dynamically select energy efficient path as per the requirement of dynamic topological changes in the network.

ENERGY MANAGEMENT OF AD- HOC NETWORKS

In ad hoc networks, the equipment always uses exhaustible energy such as batteries. The fact is that mobile computing is sprouting quickly with proceeds in wireless communications getting smaller and more efficient; advances in battery technology have not yet accomplished the stage. So, advanced power saving techniques is necessary. A variety of techniques can be used to cope with power insufficiency. Table 1 lists some of power saving techniques at ad hoc networks' protocol layers. Based on the analysis of multicast routing in ad hoc networks, we propose a distributed multicast routing protocols—the On Demand Based Energy Efficient Routing Protocol (ODBEERP), which is based on the device's energy.

Table 1 : Power Saving Techniques at ad hoc networks Protocol layers

Protocol Layer	Power Saving Techniques
Application Layer	Adopt an adaptive mobile quality of service (QoS) framework
Transport Layer	Avoid repeated retransmissions. Handle packet loss in a localized manner
Network Layer	Consider route relaying load. Optimize size of control headers
Data-Link Layer	Avoid unnecessary retransmission. Turn radio off (sleep) when not transmitting or receiving

On Demand Based Energy Efficient Routing Protocol (ODBEERP)

The main aim of proposed protocol is to discover the minimum power-limitation route. The power limitation of a route is decided by the node which has the minimum energy in that route. So compared with the minimum node energy in any other route, the minimum node energy in the minimum power-limitation route has more energy. We have also proposed a more accurate analysis to track the energy consumptions due to various factors, and improve the performance during path discovery and in mobility scenarios. The proposed protocol is evaluated with object oriented discrete event simulator environment. Simulation results shows that the ODBEERP achieves good throughput, less delay, high packet delivery ratio and good energy efficiency than the existing protocol PEER.

SIMULATION MODEL AND PARAMETERS

The Proposed protocol is implemented with the object oriented discrete event simulator. In our simulation, 50 mobile nodes move in a 1200 meter x 1200 meter square region for 50 seconds simulation time. We assume each node moves independently with the same average speed. All nodes have the same transmission range of 250 meters. The simulated traffic is Constant Bit Rate (CBR).

Our simulation settings and parameters are summarized in table 2

Table 2 : Simulation Setting & Parameter

No. of Nodes	50
Area Size	1200 X 1200 m^2
Mac	802.11
Radio Range	250m
Simulation Time	50 sec
Traffic Source	Constant Bit Rate (CBR)
Packet Size	512 bytes
Mobility Model	Random Way Point
Max.& Min.Speed	10 & 0.5 m/s

PERFORMANCE METRICS

We evaluate mainly the performance according to the following metrics.

Throughput and Delay:

Throughput is generally measured as the percentage of successfully transmitted radio-link level frames per unit time.

Transmission delay is defined as the interval between the frame arrival time at the MAC layer of a transmitter and the time at which the transmitter realizes that the transmitted frame has been successfully received by the receiver.

Data Packet Delivery Ratio: The data packet delivery ratio is the ratio of the number of packets generated at the sources to the number of packets received by the destinations

End-To-End Delay: This metric includes not only the delays of data propagation and transfer, but also all possible delays caused by buffering, queuing, and retransmitting data packets.

Energy Consumption per Packet: It is defined by the total energy consumption divided by the total number of packets received. This metric reflects the energy efficiency for each protocol.

IMPLEMENTATION

The simulation results from NS2 with respect to the following performance metrics are shown in the following figures.

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MEDIAN LATENCY:

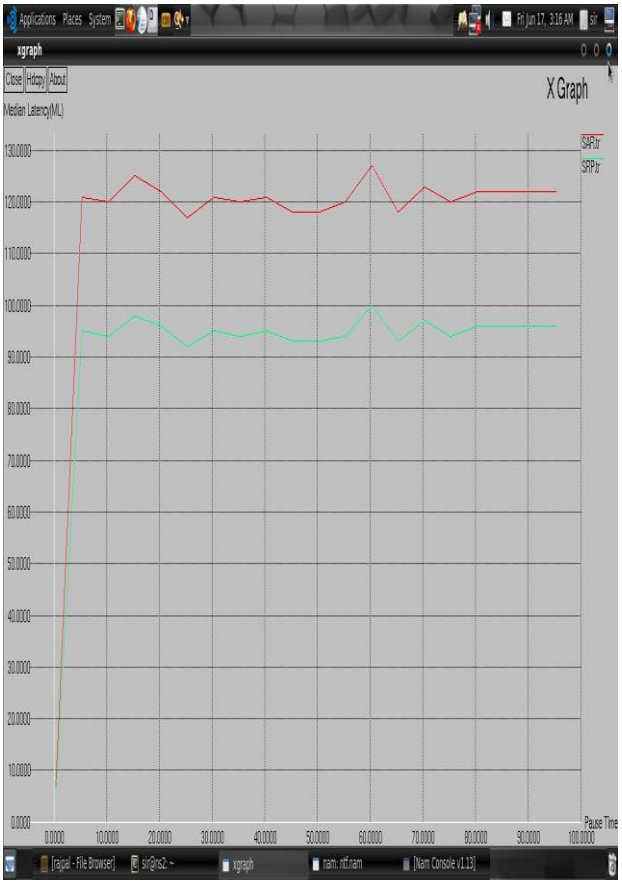

Fig.: 1

PACKET DELIVERY FRACTION (PDF):

Fig.: 2

AVERAGE END-TO-END DELAY (AED):

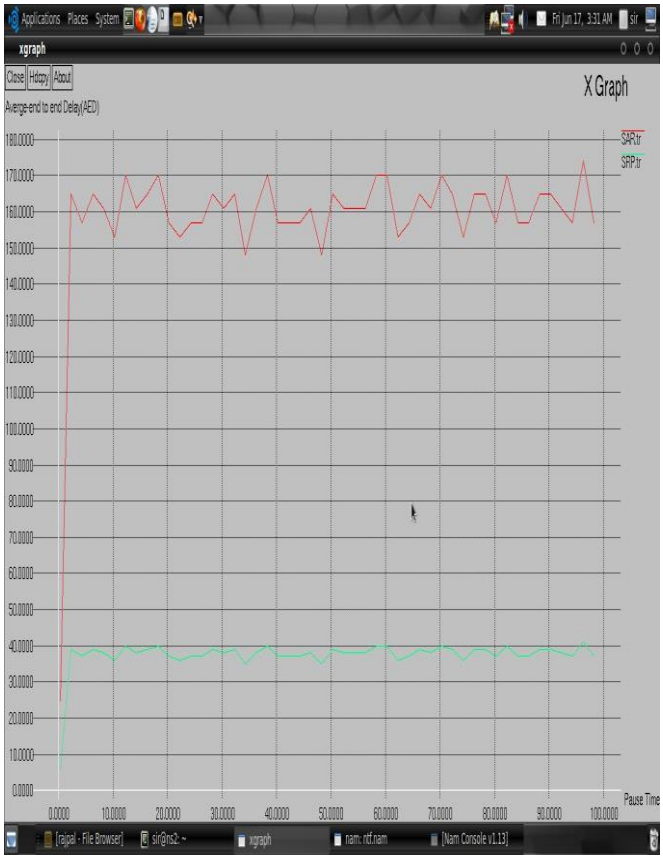

Fig.: 3

PERFORMANCE ANALYSIS

MEDIAN LATENCY (ML):

Figure 1, shows the simulation results of the performance metric, median latency. The time taken by the route discovery packet to reach from the source to destination is known and median latency. The less time to discover the route to the destination indicates the higher performance of the protocol. SRP graph shows lower medial latency graph, which means it takes less time in the route discovery process when compared to SAR.

PACKET DELIVERY FRACTION (PDF):

Figure 2, shows the results of the performance metric, packet deliery fraction. SAR cosistently outperforms SRP in terms of packet deliery fraction at lower pause times inn the simulation. This shows that the packet deliery ratio is higher of SAR the in SRP at lower pause time. At higher pause times the PDF graph for SRP increases gradually. So at the higher pause time SRP performance increases compare to SAR. Packet delivery ratio also increases compare to SAR.

AVERAGE END-TO-END DELAY (AED):

Figure 3 shows the simulation results of the performance metric, average end-to-end delay. A higher value of end-to-end delay means that the network is congested and hence the routing protocol doesn‘t perform well. SAR graph for

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AED shows higher value compared to SRP. Which means SAR Protocol used network more is more congested compare to SRP used network. Where as SAR AED graph increases as the simulation time increases, indicating the congestion in the network as the simulation time increases.

CONCLUSION

In MANET, it is very important to design energy-efficient routing protocols. Incase if we have not considered a careful design, an energy-efficient routing protocol could have much poor performance than a normal routing protocol. In this paper, we first derived an analytical model to more track the energy consumption. We have also discussed the energy consumption technique using Topology Control Approach. Based on these observations and our analysis, we propose a ODBEERP protocol with a quick and low overhead path discovery scheme and an efficient path maintenance scheme for reducing energy consumption. Our performance studies show that ODBEERP protocol reduces routing overhead and path setup delay as compared to PEER and MTRTP, and is highly adaptive to the environment change. ODBEERP performs much better than normal energy-efficient protocol in both static scenario and mobile scenario, and under all circumstances in terms of node mobility, network density, and load. In mobile scenarios, ODBEERP can reduce transmission energy consumption up to 50 percent in all simulation cases compared to the conventional energy efficient routing protocol MTRTP and PEER.

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