Power Aware Routing for Path Selection with Minimum Traffic in Mobile Adhoc Network

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ABSTRACT— A mobile Ad-hoc network (MANET) is a collection of wireless nodes that forms a network without central administration. The nodes in such kind of network serve as routers as well as hosts. The nodes can forward packets on behalf of other nodes and run user applications. These devices are operated on battery which provides limited working capacity to the mobile nodes. Power failure and the energy consumption of the nodes is a critical factor in the operation of a mobile ad hoc network. The performance of the node can be hampered by power failure, which affects the ability of node to forward the packet and hence affects the overall network lifetime. So an important objective is to consider Energy Aware design of network protocols for Ad hoc network environment. Different approaches can be applied to achieve the target and different energy-related metrics that have been used to determine energy efficient routing path. More efficient algorithm is proposed here, which tries to maximize the lifetime of network by minimizing the power consumption during the route establishment from source to destination. The proposed algorithm is incorporated with the route discovery phase of AODV and by simulation using NS/2 it is observed that the proposed algorithm is better than AODV in terms of packet delivery ratio and network lifetime.

Keywords— MANET; AODV; PAR; DSR; Online Max-Min; LEAR; Packet Delivery Fraction

I. INTRODUCTION

Mobile ad-hoc network is a group of wireless mobile nodes that forms a provisional network without any centralized administration. In MANET the communication between the mobile nodes is done via multi-hop paths. It may be necessary for one node to enroll other nodes forwarding a packet to its destination due to the limited transmission range of wireless network interfaces. Each mobile node operates as a host as well as a router forwarding packets for other mobile nodes in the network which may not be within the direct transmission range of each other. Each node participates in route discovery and in an ad-hoc routing protocol which allows it to determine multi-hop paths through the network to any other node. This idea of mobile ad-hoc network is also called infrastructure less networking, since the mobile nodes in the network dynamically establish routing among themselves to form their own network. Nodes operate in shared wireless medium. Network topology changes unpredictably and very dynamically. Radio link reliability is an issue. Connection breaks are very frequent. Furthermore, parameters like density of nodes, number of nodes and mobility of these hosts may vary in different applications. There is no stationary infrastructure. Since there is no stationary infrastructure there is are some factor which become a critical for the communication. The main critical factor in Mobile Adhoc network is power consumption. Due to this there delay during the data packet delivery and decrease the network lifetime. There are some many protocols for overcoming this problem. Routing in MANET is challenging due to node mobility, limitations for transmission bandwidth, battery power, and CPU time. In MANET nodes cooperate in routing the packets to destination. Each node in the network communicates only with those nodes that are located within its communication range. The distance between source and destination may be at multiple hopes. Death of few or even single node due to energy exhaust will cause the breakdown in communication of entire network. While taking accumulated energy we will check the status of each node and it can be estimated after transmitting the required level path will be discarded.

Also as the type and size of data known, the battery status of every node can be estimated after transmitting the required data, care will be taken while selecting the route such that any node does not get exhausted completely after the data transmission and there by become dead. In such case the alternate route will be selected. The estimation of battery status can be done from the details send by the node when it sends route request packet. In route request packet the header file has the following information. Source_id, Destination_id, Type of Data to be transfer, Total Battery Status, Total Traffic level and Node_id. Total traffic level is calculated from the packets buffered in the interface queue of the node. This problem is solved using Power Aware Routing (PAR) Protocol which increase the network lifetime and reduce the delay.

II EXISTING SYSTEM

The MANET environment is typically characterized by energy-constrained nodes, variable-capacity, bandwidth-constrained wireless links and dynamic topology, leading to frequent and unpredictable connectivity changes. Since those mobile devices are battery operated and extending the battery lifetime has become an important objective, researcher and practitioners have recently started to consider power-aware design of network protocols for the Ad hoc networking environment. As each mobile node in a MANET performs the routing function for establishing communication among different nodes the “death” of even a few of the nodes due to energy exhaustion might cause disruption of service in the entire network. In critical environments such as military or rescue operations, where ad hoc networks will be typically used, conserving of battery power will be vital in order to make the network operational for long durations. Recharging or replacing batteries will often not be possible. This makes the study in energy-aware routing critical. The challenge in ad hoc networks is that even if a host does not communicate on its own, it still frequently forwards data and routing packets for others, which drains its battery. Switching off a non-communicating node to conserve battery power may not be always a good idea, as it may partition the network. In a conventional routing algorithm, which is unaware of energy budget, connections between two nodes are established between nodes through the shortest path routes. This algorithm may however result in a quick depletion of the battery energy of the nodes along the most heavily used routes in the network. The main focus of this research is to design a power-aware routing protocol that balances the traffic load inside the network so as to increase the battery lifetime of the nodes and hence the overall useful life of the ad hoc network.

Different approaches can be applied to achieve the target.[2] Transmission power control and load distribution are two approaches which minimizes the active communication energy, and sleep/power-down mode is used to minimize energy during inactivity. The primary objective is to minimize energy consumption of individual node. The load distribution method tries to balance the energy requirement among the nodes and increases the network lifetime. This can be done by avoiding over-utilized nodes while selecting a routing path. Transmission power control approach, the stronger transmission power is used to increase the transmission range and reduces the hop count to the destination, if weaker transmission power is selected then it makes the topology sparse, which partitions the network and produces high end-to-end delay due to a larger hop count. To determine energy efficient routing path, different energy-related metrics have been used like: Energy consumed/packet, Time to network partition, Variance in node power levels, Cost/packet, and Maximum node cost. Transmission power control approaches are discussed in Flow argumentation Routing (FAR)[3] where the network is considered as static network and tries to find the optimal routing path for a given source-destination pair that minimizes the sum of link costs along the path. Online Max-Min (OMM)[4] achieves the same but the data generation rate is not known in advance. Power aware Localized Routing (PLR) assumes that a source node has all location related information of its neighbors and the destination. Minimum Energy Routing (MER) [5] shows issues like obtaining accurate power information, associated overheads, maintenance of the minimum energy routes in the presence of mobility and implements the transmission power control mechanism in DSR and IEEE 802.11 MAC protocol. Some proposals considers load distribution approach are provides in Localized Energy Aware Routing (LEAR) Protocol [6] is based on DSR but modifies the route detection procedure for balanced energy consumption. In LEAR, a node concludes whether to forward the route-request message or not depending on its residual battery power. Conditional max-min battery capacity routing (CMMBCR) Protocol uses the concept of a threshold to exploit the lifetime of each node and to use the battery fairly. Existing system increases lifetime of network and reduces the power expenditure during the route establishment using a secure cryptographic method. Only the secure node having required energy level can participate in route discovery phase and data transmission. This algorithm can transfer both real time and non real traffic by providing energy efficient and less congested path between a source and destination.

III PROPOSED SYSTEM

AODV routing protocol is a reactive routing protocol; therefore, routes are determined only when required. Hello messages may be used to detect and monitor links to neighbors. If Hello messages are used, each active node periodically broadcasts a Hello message that all its neighbors receive. Because nodes periodically send Hello messages, if a node fails to receive several Hello messages from a neighbor, a link break is detected. When a source has data to transmit to an unknown destination, it broadcasts a Route Request (RREQ) for that destination. At each intermediate node, when a RREQ is received a route to the source is created. If the receiving node has not received this RREQ before, is not the destination and does not have a current route to the destination, it rebroadcasts the RREQ. If the receiving node is the destination or has a current route to the destination, it generates a Route Reply (RREP). The RREP is unicast in a hop-by-hop fashion to the source. Control messages are route request route reply and Hello message. Dynamic Source Routing (DSR) also belongs to the class of reactive protocols and allows nodes to dynamically discover a route across multiple network hops to any destination. Source routing means that each packet in its header carries the complete ordered list of nodes through which the packet must pass. Multipath routing appears to be a promising technique for ad hoc routing protocols. Providing multiple routes is beneficial in network communications, particularly in MANETs, where routes become obsolete frequently because of mobility and poor wireless link quality. The source and intermediate nodes can use these routes as primary and backup routes. Alternatively, traffic can be distributed among multiple routes to enhance transmission reliability, provide load balancing, and secure data transmission. The multipath routing effectively reduces the frequency of route discovery therefore the latency for discovering another route is reduced when currently used route is broken. Multiple paths can be useful in improving the effective bandwidth of communication, responding to congestion and heavy traffic, and increasing delivery reliability.

In PAR a feasible path is searched out which satisfies the bandwidth constraint. In contrast to the flooding based algorithms, PAR search only a small number of paths, this limits the routing overheads. In order to maximize the chance of finding a feasible path, the information is collectively utilized to make hop by hop selection. This protocol does not consider the QoS requirement only but also considers the optimality of the routing path in terms of energy efficiency. If a specific QoS request is not being asked by a user then high energy paths are chosen by PAR in order to improve the overall network lifetime. In case of PAR a simple energy consumption model has been used to calculate the energy values at different times. This model is already discussed in existing system. The nodes involved in the communication are continually in motion and also deplete their energy in transmission and reception of each bit. An out of range node or an energy depleted node may cause a link failure. A link failure may trigger an end to end reconstruction of the route through fresh route discovery process or a local repair that determine an alternate path to circumvent the failed link. Global reconstruction is costly and prohibitive when frequent link failures occur. PAR uses the local repair for route maintenance. Most of the routing protocols depend on IEEE 802.11 with acknowledgement to confirm packet delivery. When a node does not receive any acknowledgement in a limited period of time, the link is considered as broken; and route maintenance starts. Whenever a link failure takes place either due to energy depletion or mobility, PAR invokes a route maintenance phase.

POWER AWARE ROUTING ALGORITHM

The general algorithm for power aware routing is shown below

If (T_O_L = =NRT)
Let N different values of R are received, Where R ≥1

If (N = = 0)
Send negative acknowledgement to the source that path cannot be established.

Else-if (N = = 1)
Acknowledge the source with this path.

Else-if (N > 1)
Select the path with min {T_T_L} acknowledge the source with the selected path.

Else-if (T_O_L = =RT)
Let N different values of R are received, where R≤2

If (N = = 0)
Send negative acknowledgement to the source that path cannot be established.

Else-if (N = = 1)
Acknowledge the source with this path.

Else-if (N > 1)
Select the path with min {T_T_L} Acknowledge the source with the selected path.

Block Diagrams For Modules
The below Figure 1 explains the network formation with route discovery. Each time the route is discovered it will be updated in the routing table.

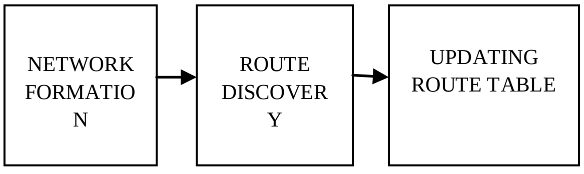

Fig 1 Block diagram for Network Formation

Implementing Power Aware Routing Algorithm

The below Figure 2 explains the selection of path with minimum traffic level to select the path it go for a condition of selecting N value received by R. The value of R should be greater than 1.

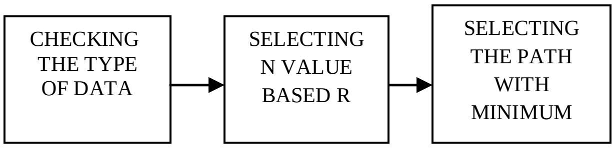

Fig 2 Block diagram for path selection with minimum traffic

Route Discovery Algorithm

The above Figure 3 describes how the path is elected with maximum energy. The node create a route request packet with three special field. The node will be attached with energy metrics. The node will be attached with energy metrics. This packet will be forwarded to the neighboring nodes. The maximum energy is calculated and received by destination. The destination will select a path with maximum energy.

List of Modules

The implementation of the system, which is composed of following modules:

- Network model
  - Parameters of route search
- Power aware routing (PAR) Algorithm
  - Route Discovery Algorithm
  - Energy Based Path Selection
- Maintenance and Performance evaluation
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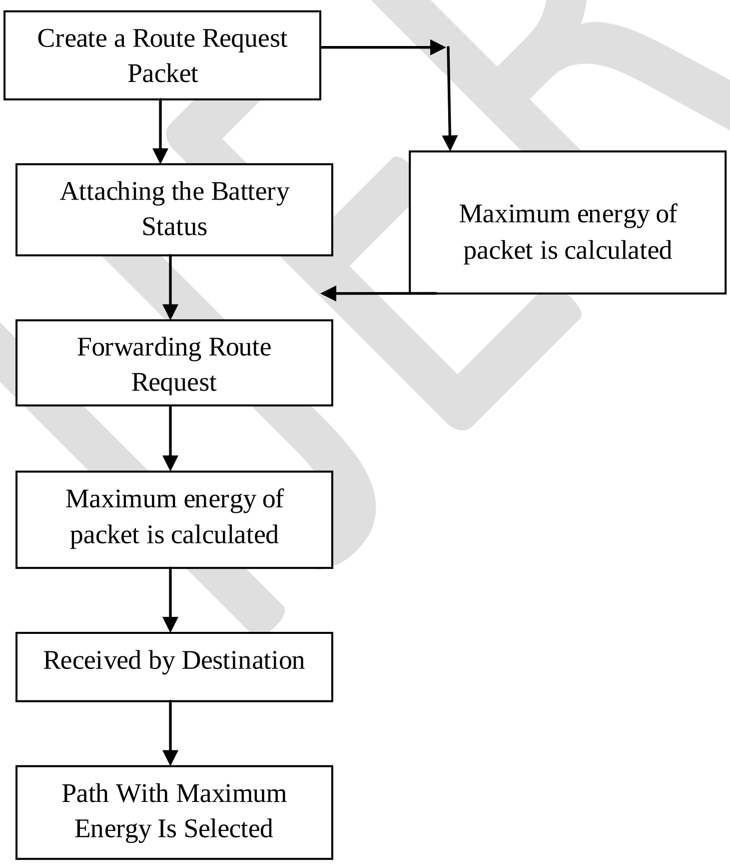

Fig 3 Block diagram for path selection with maximum energy

Network Model

We setup for 20, and 50 nodes in an area of 1000m*1000m. In the different scenarios from small network to large networks, value for packet delivery ratio has been observed by varying pause times from 0 to 500 and the speed has been changed form 1 meter per second to 25 meters per second.

Parameters on each node each node has 3 variables:
1. Node_ID: Used for node identification. Each node is identified by unique ID.
2. Battery Status (B_S): Total energy at node.
3. Traffic Level (T_L):Number of packets stored in the interface queue of the node.

Route Search Mechanism

At the time of route discovery phase, a route request (RREQ) packet send or broadcasted by the source to all its neighbor nodes for getting information about destination. RREQ packet's header includes source_id, destination_id, T_O_L (type of data to be transfer), T_B_S (Total Battery Status), T_T_L (Total Traffic Level), and Node_IDs.

Maintenance and Performance Evaluation

The performance of the proposed system is analyzed through the following

- Network Lifetime: Network life time is defined as the time taken for 50 % of the nodes in a network to die. The effect of pause time and speed of nodes on network lifetime is evaluated.

Packet Delivery Fraction (PDF): Packets may be lost due to sudden link failures, or during route maintenance phase. PDF is the fraction of successfully received packets, which survive while finding their destination. This performance measure determines the efficiency of the protocol to predict a link breakage and also the efficacy of the local repair process to find an alternate path. The completeness and correctness of the routing protocol is also determined

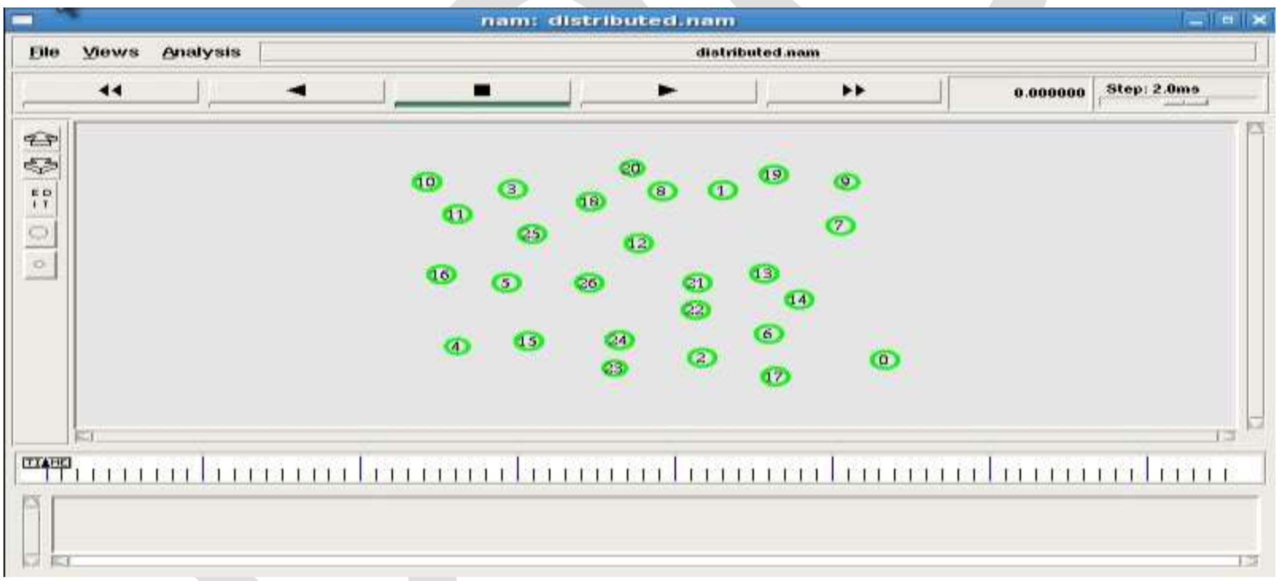

Fig 4 Network Formation

Route Reconstruction in Q-PAR: Whenever a link failure takes place either due to energy depletion or due to mobility, route reconstruction or route repair phase is invoked in the routing protocols. Average end-to-end delay is the delay experienced by the successfully delivered packets in reaching their destinations.

IV SIMULATION RESULT

The performance evaluation graph of the data packet delivery ratio for the Power Aware Routing (PAR) is estimated. It is also compared with the other energy aware routing protocol named Localized Energy Aware Routing Protocol (LEAR). The Figure 4 and Figure 5 show the output for the proposed system. The Figure 4 shows the output for the network model. The parameters are set as default in each node. The Figure 5 shows the output for data transmission. The data packet is transmitted from the source to the

destination based on certain criteria. From the available paths, the path with nodes of minimum traffic and with high battery status is selected as the optimal path. The output is shown below. The below graph 1 shows the data packet delivery ratio of a node while transmitting the data from source to destination. The graph1 represent the
packet delivery ratio of a node based on distance between the nodes.

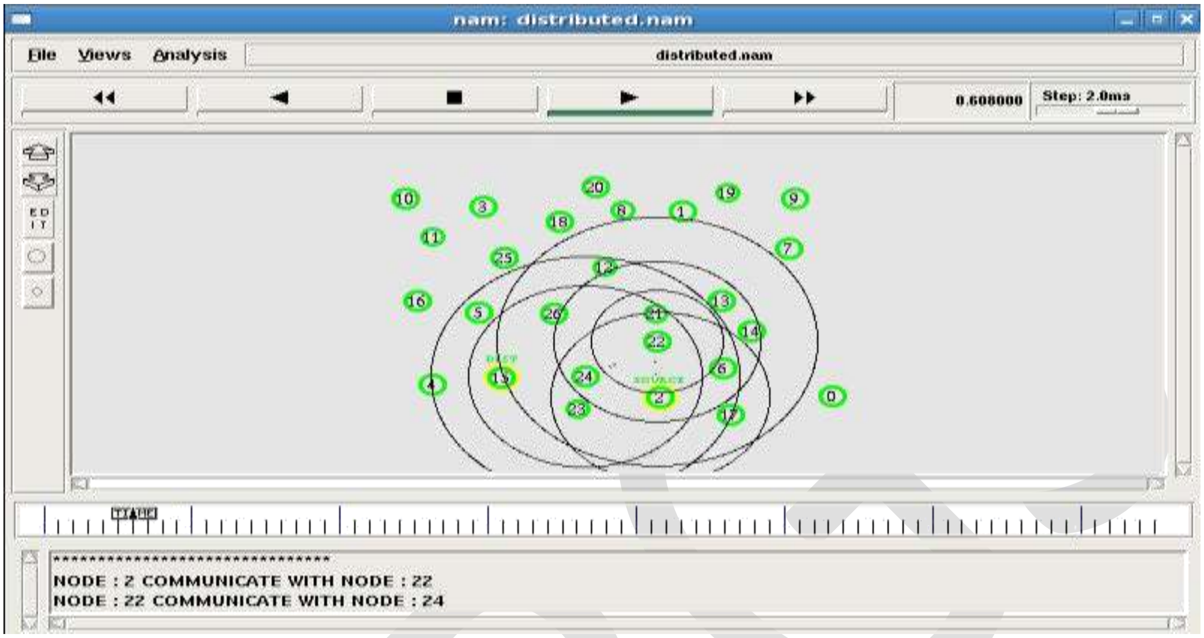

Fig 5 Data delivering through optimal path

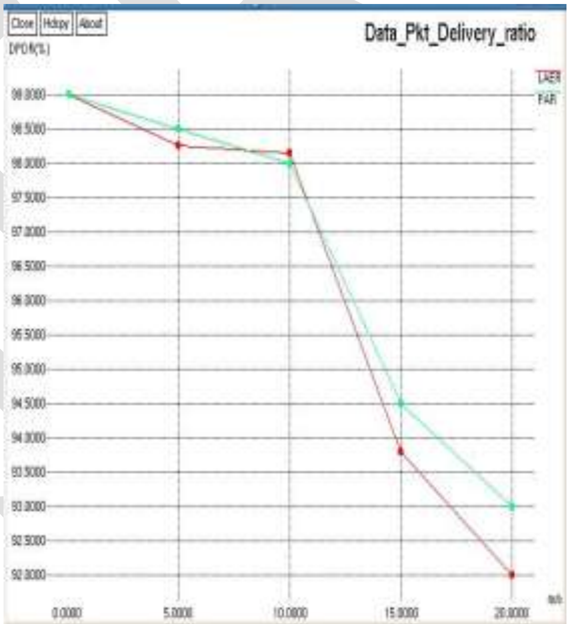

Fig 6 Graph 1 Data Packet Delivery Ratio of LEAR vs PAR

In this the protocol from Existing System and proposed system is compared. That is LEAR is compared with Power Aware Routing.

Table 1 Data Packet Delivery Ratio for LEAR

SNO	STABILITY WEIGHT	PERCENTAGE
1.	0	99.0000
2.	5.0000	98.3000
3.	10.0000	98.2000
4.	15.0000	93.8000
5.	20.0000	92.0000

The below Table 5.6 show, how the data packet delivery ratio of a node varies based on its distances by using LEAR.

V CONCLUSION

Energy efficiency is one of the main problems in a mobile ad hoc network, especially designing a routing protocol. The existing work aims at discovering an efficient power aware routing scheme in MANETs and analyzing the derived algorithm with the help of NS-2. This scheme is one of its types in ad-hoc networks which can provide different routes for different type of data transfer and ultimately increases the network lifetime. However, delivery latency is increased by using SPAR of existing system; hence we proposed the energy stable PAR routing technique that determines bandwidth constrained paths that are most likely to last for the session in ad-hoc networks that have paucity of energy. The protocol considers only energy stability for local reconstruction of the routes to avoid packet loss and costly global reconstruction. The protocol is able to enhance the network lifetime by performing delay repair which occurs due to energy depletion of nodes and significantly improve the overall efficiency of packet delivery.

FUTURE ENHANCEMENT

However, a priori estimation of the bandwidth and admission control to ensure bandwidth availability between wireless links is required to ensure the performance of the protocol. This prior knowledge may be an overhead and in future this can be avoided

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