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"Threshold based Energy efficient Fault Tolerance Transparent scheme in MANET"

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Abstract

Mobile Ad Hoc network (MANET) is a collection of wireless mobile terminals or nodes that can communicate with one another, while not any mounted networking infrastructure. The nodes in MANET are mobile, since network topology in MANET is frequently changes. The proper routing and energy management become a critical problems in dynamic network. Wireless communication has the advantage of permitting unbound communication, which suggests reliance on moveable power sources like batteries. Energy efficient routing problems are important within MANET dynamic environment. Energy must be optimally utilized in order, so that the nodes will perform their action satisfactorily. This paper proposed the topology transparent routing to improve network performance. The experiment included the three different scenarios of network topology. In first Scenario, the network is static, means nodes are not movable. In second scenario, the nodes are movable and also the energy contained nodes are established shortest path and in third modified scenario, the routing procedure according to availability of higher energy level of mobile nodes. The shortest path mechanism enhancing the fault tolerance and nodes selection is based on demand manner. The proposed third scenario, performance is compared with rest of two scenarios and observes that the proposed scheme provided the better results and also utilizes the more energy in routing and reduces unnecessary energy consumption of mobile nodes in dynamic network. The better energy utilization is also shows the long survivability of nodes in MANET. Experiment results show that out of three scenarios, the proposed third scenario gives better results in terms of energy consumption and fault tolerance.

***Index Terms*—Routing, MANET, Energy, Topology, network life time**

I. Introduction

In Mobile Ad hoc Network (MANET), nodes don't begin out conversant in the topology of their networks instead, they need to find it. The fundamental idea is that a new node could announce its presence and may listen for announcements broadcast by its neighbors [1]. Each node learns regarding nodes nearby and how to achieve them and should announce that it, too can reach them. Ad hoc network are often sub-divided into two categories. In Static ad-hoc network the positions of a node might not be modified once it becomes a part of the network, i.e. Rooftop Networks. Every device in an exceedingly MANET is liberal to move severally in any direction. The first challenge in building a MANET is mobility every device to unendingly maintain the data needed to properly route traffic. Because the hosts of Mobile Ad hoc Network is any form of mobile computing devices or communication tools that have restricted battery capability [2]. Energy constrained operation sometimes solely permits short vary of radio propagation. As the simplest way to reduce energy consumption, tend to have an interest within the impact of power management that tunes the strength of radio transmission [3]. Power management approaches within the wireless ad hoc network is loosely classified into two classes, power controlled topology management and power aware routing [4]. The topology transparency and fault tolerance in the network requires identifying link losses. The main characteristic [5] of MANET is the absence of preplanning. The topology of the network is discovered on the fly, once the network's readying. Thus, such a network should exchange variety of messages that are used to "setup" various parameters in the network. If there are solely two nodes that need to communicate with one another and are placed terribly closely to each other, then no specific routing protocols or routing selections are necessary. On the opposite hand, if there is variety of mobile hosts want to communicate, and then the routing protocols come into play. The mobile nodes operate on limited battery power which tends to decay over time. Therefore it becomes necessary to

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provide communication with minimum loss of power with energy conservation.

To avoid the extinction of nodes because of exhaustion of their battery power, a proper energy conservation scheme is necessary. The energy aware routing algorithms ensure a distribution of the transmission, receiving and sensing cost among the constituent nodes [6]. Many routing protocols within the MANET follow distance vector approach for route selection. Protocol selects a route with minimum cost, sometimes results to include one node for many paths due to its position in network. In this case node looses its battery power quickly and exhausted. The proposed energy efficient topology transparent scheme is reduces the early exhaustion of mobile nodes.

II. Types of Routing Protocols

Routing within the MANETs may be a difficult task and has received an incredible quantity of attention from researchers. Due to promising delivery the capability to handle dynamic connectivity are the foremost necessary problems for routing protocols in MANET [7, 8]. Once the path is identified between source node and destination node, the routing protocol ought to be ready to deliver data via this path. If the property of any two nodes changes over time routes are become littered and then routing protocol has to apply a policy to recover and search for an alternate path, if it possible. Routing protocols are classified into three different categories as:

A. Proactive Routing Protocols.
B. Reactive Routing protocols.
C. Hybrid Routing Protocols.

A. Proactive Routing Protocols

The DSDV (Dynamic Source Distance Vector) is a proactive protocol. In proactive or table driven routing protocols, every node incessantly maintains up-to-date routes to each different node in the network. Routing information is transmitted sporadically throughout the network to keep up routing table consistency. The dissented areas contain the information about routing connected tables, this helps in broadcasting the network structure. The proactive protocols are not appropriate for larger networks, as they have to maintain node entries for every node within the routing table.

B. Reactive routing Protocols

The AODV (Ad-hoc on Demand Distance Vector) is a reactive routing protocol. With on demand protocols, if a source node needs a route to the destination, and if this information is not available then, this protocol initiates a route discovery method which fits from one node to the opposite till it reaches to the destination or an intermediate node. This protocol searches for the route in an On Demand manner and establishes the connection for transfer of packet. If a node needs to send a packet to another node it floods the route request packets throughout the network.

C. Hybrid Routing Protocols

The ZRP (Zone Routing Protocol) is a hybrid routing protocol [8]. This protocol is combination of proactive routing approach and reactive routing approach. It simply uses them in different zones. These zones communicate with each other, if the destination exists in another zone.

III. Literature Survey

Earlier research works based on energy consumption and fault tolerances will be discussed in this section.

Ghabri and Bellalounap presented the combinatorial optimization, which provides applicable methods and functions to optimize the calculation of consumed energy, distance, and routing path cost during data transmission to the sink in wireless sensor networks [9]. Fault tolerant protocols and approaches then employed to ensure reliability and selection of best paths in order.

Priyadharshini and Thamarabi proposed combined node and link lifetime in route life-prediction algorithm. They explored the dynamic nature of mobile nodes such as the energy drain rate of nodes and the relative mobility estimation rate at which adjacent nodes move apart in a route-discovery period, which predicts the lifetime of routes that are discovered [10]. Then the longest lifetime route for data forwarding is selected to make route decision. Node lifetime routing algorithm depends upon the energy state of nodes, such as residual energy and energy drain rate. This routing algorithm often selects a path consisting of nodes that may survive for the longest time among multiple paths.

Sisodia and Raghuwanshi have removed the problem of conserving battery usage within a mobile ad- hoc network [11]. Other previous research works has gone in different energy conserving strategies spanning different network

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layers. At network layer author suggested a scheme to minimize total power needed to route the packet and to maximize the lifetime of node, routing algorithm must select the best path. Presented work shown that E-DSDV routing is efficient, if node motion is very slow and energy utilization is also efficient but E-DSR gives better result as compared to E-DSDV protocol in high rate of node mobility.

Phu Hung Le presented two interference-aware multipath protocols named Node-disjoint Interference-Aware Multipath Routing protocol (NIA-MPOLSR) and the Link disjoint Interference-Aware Multi-path Routing protocol (LIA-MPOLSR) [12]. Author given a novel Source Routing Interference-Aware Multi-path Protocol (SR-IA-MPOLSR) for mobile ad- hoc networks. This protocol used source routing mechanism, parallel transmission via the minimal interference paths and adapts quickly to the change of topology in MANETs. The other strong point of SR-IAMPOLSR is that it finds paths with the computational complexity in polynomial time instead of NP-hard of other protocols. This protocol was compared with two typical protocols AOMDV (multipath protocol) and DSR in terms of packet delivery fraction, end-to-end delay, and routing overhead when the RTS/CTS mechanism is alternatively enabled and disabled. Simulation results showed that SR-IA-MPOLSR significantly improves the network performance and also proved that the network performance is reduced when RTS/CTS mechanism is used.

Gabri Malek et al. proposed a new energy consumption model and a new routing algorithm in wireless Ad-hoc Networks, especially for the Ad-hoc Networks clients [13]. The network node energy-limited routing protocol is the central issue of their work. EAODV avoids invalid routing discovery, and reduces the probability of link breaking after routing is discovered. They showed that Low energy nodes, achieves longer network lifetime and minimizes network energy consumption compared to the traditional AODV protocols.

Mishra and Satpathy developed the algorithm to maximize the life-time of a wireless ad hoc network [14]. They presented a solution called LEAD (Lowest Energy Ad hoc network Design) algorithm which is basically an improvement on ANDA (Ad hoc Network Design Algorithm). The algorithm LEAD dealt with energy efficient round scheduling of cluster head allocation of nodes and then followed by allocation of nodes to the cluster heads maximizing network lifetime using ANDA.

IV. Experiment Setup

Network Simulator 2 is the result of an on-going effort of research and development that is administrated by researchers at Berkeley. It is a discrete event simulator targeted at networking research. It provides substantial support for simulation of TCP, routing, and multicast protocols [15]. Table.1 shows the parameters and value of experimental setup:

Table 1: Parameter and Values

Parameters	*Values*
Terrain Size	*800×600*
Network Protocol	AODV
Analysis Time(sec)	100
Transmission Range	550m
Transport Layer Protocol	TCP, UDP
Languages	C++, OTcL and AWK
Number of packet transmit in 1sec	2
Application Data	FTP, CBR
Data Size (bytes)	512,1024
Number of nodes	50
Speed in between (m/s)	0-30

D. Performance Evaluation

The following different performance metrics have been used to evaluate the experimental results:

(1) Packet Delivery Ratio

The Ratio of the data packets received at the destination nodes to the packets that were sent by the sources.

(2) Routing Load

Number of routing packets (and supporting protocol control packets) transmitted per data packet delivered at the destination.

(3) Throughput (throughput or network throughput)

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Throughput is average rate of successful message delivery over a communication channel from source to destination. This data may be delivered over a physical or logical link, or pass through a certain network node or mobile nodes. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

V. Proposed Reliable Routing Scheme

The nodes in the network are communicated with each other for sending and receiving data in the network. Most of the nodes are sender or receiver and rests of the nodes are intermediate node in the network. In this work, we consider the AODV reactive routing protocol for communication in MANET. The AODV protocol routing function is modified in the section of path. The energy reliable path is selected by the receiver after giving reply to sender then the data delivery starts. The proposed fault tolerance topology transparent scheme provides proper data receiving; it also improves the life time of the network. Network life time is an important condition for deciding the effectiveness of the network protocols. The network is created for a particular period of time and this network also provides services during this period. Fault tolerance and the energy consumption are necessary in evaluating network performance. However, survivability continues to be a preliminary idea and desires to be worked on more understandable before using it to evaluate network protocols.

While considering a lot of helpful metric for routing protocol performance is network survivability. In this way, We want that the protocol ought to make sure that connectivity in a network is maintained for as long as attainable, which the energy health of the whole network ought to be of identical order. This is often in distinction to energy optimization protocols that find the optimum methods and it exhaust the energy of nodes on those paths; going away from the network gives a wide inequality in the energy levels of the nodes, and eventually forms the disconnected subnets. If nodes within the network deplete the energy, then the nodes within the center of the network still provide connectivity for extending the network and the network partition time will increase. This

leads to an additional degradation of the network. This is often the concept of survivability of networks. The proposed algorithm improves the performance of network and provides reliable efficient energy routing.

E. Proposed Algorithm

Mobile sensor node = N_n; // Number of mobile nodes
Initial Node Energy=IN_E //Consider Random for each node.
Remaining Energy=R_E
Sender node = S_n; // sub part of N_n
Receiver Node = D_n; // sub part of N_n
Time of Simulation = t0 / t0=100seconds, th =10jule
Routing protocol for wireless communication = AODV;
MAC Standard= 802.11
Output Calculated=PDR, Throughput, Energy Utilization and Consumption Analysis
Mobile nodes radio range = RR; // radio range for communication is 550 meters same as consider.

```
RREQ_Pks_Broadcast(Sn, Dn, RR)
{
If ((RR<=550m) && (Next_Neighbour >0) && (RE>th))
{
Start Procedure of route establishment or compute route;
{
if{routing_table1->insert (routing_table1 -> routing_table);
// send RREQ to intermediate
routing _table1->insert(RREP_Nexthop, RE,)
 //Store RREP of next hop,
go to compute route;}
else
{
routing_tablen->insert(routing_tablen->routing_table);
// send RREQ to destination for n record.
 }
routing _table n->insert(RREP_Nexthop, RE)
 //Store RREP of Destination.
if (Dn = = Available)
{
  Find Link of higher Energy count (RE = = highest) ;
Send ACK with routing_table1;
Data_packet_send (s_no, next_neighbour, type);
}
Else
 {
   Destination (Dn) is not Exist;
  }

 }
else
{
Dn un-reachable; }
```

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}

VI. Result and Analysis

The simulation results show the analysis and performance in different network scenario. The routing performance of proposed scenario, which is based on threshold technique, is better as compared to static and normal dynamic routing.

F. PDR Analysis

The proper data sending and receiving provides the better performance of dynamic network. The Packet Delivery Ratio (PDR) performance metrics evaluated the percentage of successful data received at destination. The numbers of nodes in MANET are collapse early due to energy exhaustion. In this graph the PDF performance of static network, normal energy routing and proposed reliable routing scheme is evaluated and identified that the PDF of proposed scheme is more about 94%.

$$PDR = \frac{\text{Packets successfully delivered}}{\text{Total packets sent}} \times 100$$

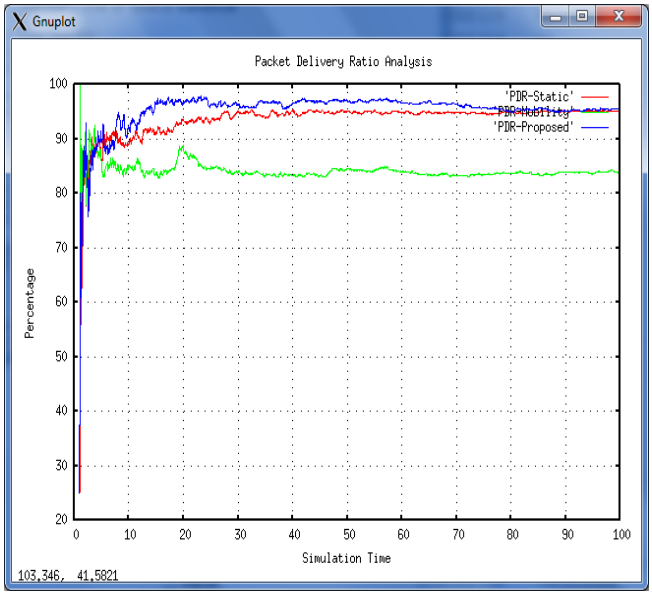

Fig.1 PDR Analysis

G. Throughput Analysis

The data receiving in per unit of time is measured through the performance metrics. The number of nodes had to be exhausted their energy in each communication and the energy depletion of mobile nodes, creating the problem of availability of nodes, that had sufficient energy for communication. The throughput of proposed fault tolerance reliable route selection method based on utmost node energy selection routing is about 2500 packets/second in end of simulation time.

$$Throughput = \frac{\text{Received Packets}}{\text{Simulation Time}} \times 100$$

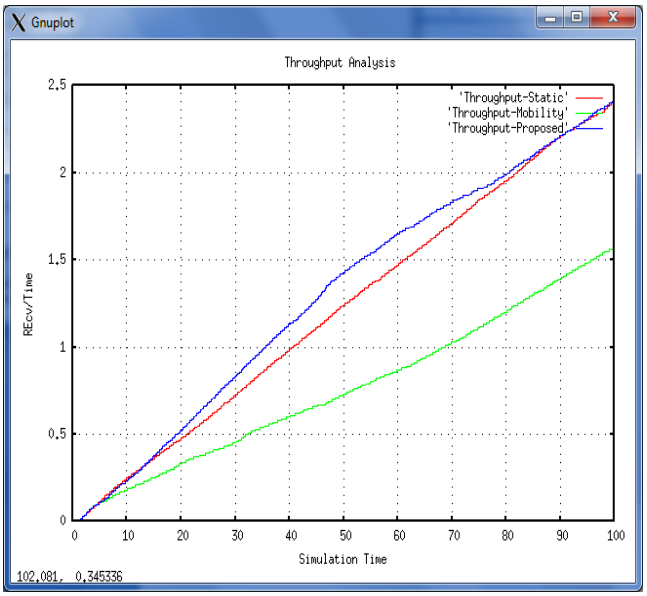

Fig.2 Throughput Analysis

H. Network Performance Analysis in all Three Cases

The accurate performance of normal energy routing and proposed MAX routing is given in Table 3. The performance metrics PDR, delay and routing load through number of packets is evaluated and observed that the proposed topology transparent scheme provides the better performance and improves the energy utilization of nodes in dynamic network with enhancement of network life time and reduction of energy consumption.

Table 2: Network Statistics

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Performance Metrics	Static	Mobility	Proposed
Total Packets Sent	6722	4741	6282
Total Packets Received	6395	3977	6006
Total Packets Forward	8559	9144	8270
Total Packets Drop	327	764	276
Total Hop count	1512	2993	4434
Packet Delivery Ratio	95.14%	83.89%	95.61%
Normalized Routing Load	2.45	3.87	2.29
Average End to End Delay	0.29 ms	0.66 ms	0.39 ms

I. Energy Consumption Analysis

The energy in mobile nodes utilized in network for data sending, receiving and sensing the neighbour for communication. In Table 3, 50 nodes are considered in this topology and find that energy utilization in proposed fault tolerance scheme is better due to better routing strategy. In static network the nodes are not moveable, but these nodes are sharing the information with receivers and in that case the shortest path scheme by default is used in communication. In proposed scheme the reliable node selected for link establishment and strong link established.

Table 3: Energy Analysis

Network Type	Number of Nodes	Total Start Energy	Total Remaining Energy	Total Energy Utilization (EP)
Static	50	4994.77	429.65	4565.11
Mobility	50	4994.64	537.58	4457.06
Proposed	50	4994.94	634.3	4360.64

J .Remaining Energy Analysis

The node energy utilization improves the life time of network and also improves the network performance in term of better data receiving without any problem. The nodes energy is very limited resource and this resource savings is necessary for working long time in the network. In the graph shown in fig 3, the remaining energy analysis of all three network scenarios are mentioned and observed that, in proposed topology transparent routing with dynamic network is saving more energy and remaining for communication. In proposed reliable energy routing, energy is utilized more as compared to normal static and dynamic routing.

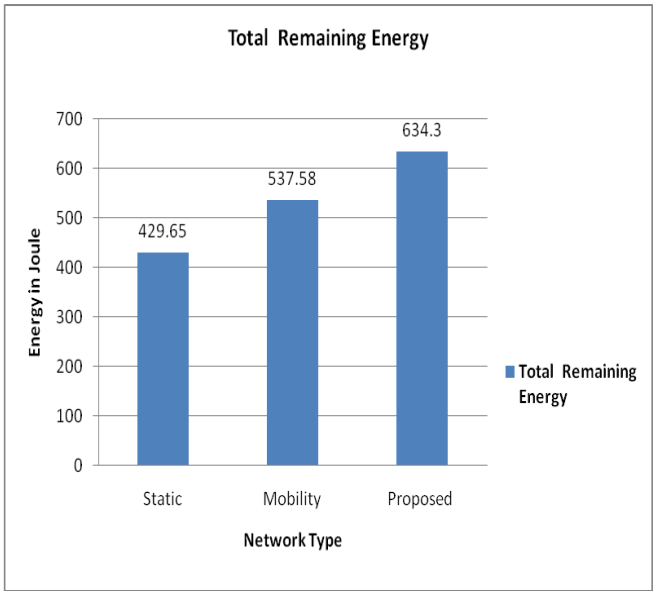

Fig.3 Remaining Energy Analysis

VII. Conclusion and Future Work

The one of the characteristics of MANET is that nodes are energy constraint where mobile nodes operate with limited battery power. Hence, it is important to save the energy consumption of the whole network so as to maximize the period of time of unintentional networks. Energy Aware Routing, the protocol that we have developed tries to confirm the survivability of low-energy networks or energy dependent network. The fault tolerance and topology transperency improves network performance. The reactive protocol like AODV directed dissemination for connection establishment; the protocol doesn't establish only optimum path but use it for communication. The concept behind the protocol is to

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find something conditionally than using the most reliable path that selected the nodes that has higher energy path for reliable communication. Therefore using an easy mechanism to send traffic though different routes helps in using the node resources more fairly. The rest of two scenario performances provide better results but the proposed scheme utilizes the more amount of energy as compared to other. The through-put and PDR is best and energy consumption the major factor reduces for better survivability of network. The proposed fault tolerance energy approach provides the better communication with lifetime enhancement.

In future extension we discuss on some other topic like security. The security is one of other important criteria to do research in field of MANET. The energy consumption is also improves in presence of attacker then applying proper security scheme to identified attacker and improves the network performance.

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