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An New Approach to Make TORA Protocol Energy Efficient

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***Abstract*- Mobile AdHoc Network (MANET) is the self organizing network. The nodes employed in the creation of network can move freely and are usually operated through battery power. The amount of battery capacity of nodes is limited and the nodes get discharged when they transmit or receive packet. TORA routing protocol created multiple routes from any source to destination. Usually the shortest path is selected for forwarding the packets which may lead overuse of some nodes and they become dead very soon which may decrease the lifetime of network. In this paper a new approach is used in which only that path will be selected for forwarding packet which has energy of nodes above some threshold level. Simulation was performed using NS-2.35 simulator and results shows that Energy Aware protocol has better performance than TORA protocol and EDTORA in terms of packet delivery ratio, energy consumption.**

Keywords: **MANET, TORA, DAG, link reversal, residual energy, NS-2.**

I. INTRODUCTION

Wireless ad-hoc networks are composed of autonomous nodes that are self- managed without any infrastructure. The most important characteristic of such networks is the independence of any fixed infrastructure or centralized administration. An Ad Hoc network is capable of operating autonomously and is completely self-organizing and self-configuring. Therefore, it can be rapid and easily deployable. Another important property of an Ad Hoc network is multi-hop capability. In this way, ad-hoc networks have a dynamic topology such that nodes can easily join or leave the network at any time. Mobile AdHoc network is used to create network where\there is no infrastructure like in case of disaster, military area etc. these networks does not need any base station for transferring data from source to destination.

Ad-Hoc network is a dynamic multihop wireless network that is established by a set of mobile nodes on a shared wireless channel. Each mobile host performs local broadcasts in order to identify its existence to the surrounding hosts. Surrounding hosts are nodes that are in close proximity to the transmitting host. In that way each mobile hosts becomes potentially a router and it is possible to dynamically establish routes between itself and nodes to which a route exists.

There are basically two types of routing protocols [3], [10]. First, when the route is created by source only when it wants to transfer data then such type of routing is called On Demand Routing Protocols. Second, there may be case where routes are created in advance and they are stored in the tables of nodes, such protocols are called Table Driven Routing protocols.
Among all On Demand Routing Protocol TORA protocol is best suited for the highly mobile network [11], it is a multi hop protocol that create multiple loop free routes from source to destination. In this paper a new Energy Aware protocol is proposed based on TORA protocol.

Simulation performed in NS-2 shows that the Energy Aware protocol leads to balanced used of energy of all nodes.

II.TORA PROTOCOL

TORA [4], [7] is a On demand routing protocol that creates multiple loop free routes from source to destination. The TORA protocol creates a DAG (Directed Acyclic Graph) directed towards destination while creating route. The TORA protocol is based on the Link Reversal Algorithm to manage link in case of link failure between nodes. It creates routes by setting "height" metric of each node. Data packets "flow" from higher nodes to lower nodes and eventually reach the destination, which has zero

height with respect to itself. A directed acyclic graph (DAG) rooted at the destination is created in every route query/reply process. There are three basic functions of TORA protocol 1. Route Creation, 2. Route Maintenance 3. Route Erasure. To perform these operations it uses QRY, UDP, CLR packets respectively. When a new route is required by the source node, it broadcasts a route query (QRY) to its neighbors. The QRY packet is then re-broadcast by neighbors until it reaches the destination. The destination node declares its height by broadcasting a route update (UPD) packet. Every node receiving the UPD packet will update its height to be higher than the height in UPD. Then the UPD packet is rebroadcast with new height in it until it reaches the source node.

TORA assigns height to each node the quintuple $h_i = (\tau_i , O_{id} , r_i , \delta_i , i)$ where first three parameters define the reference level and the remaining two parameters define the offset with respect to reference level.

τ_i = Time at which failure occurred

O_{id} = ID of originating node
r_i = one to two unique sublevels in reference level
δ_i = Integer used to order nodes with respect to reference level
i = id of the node itself

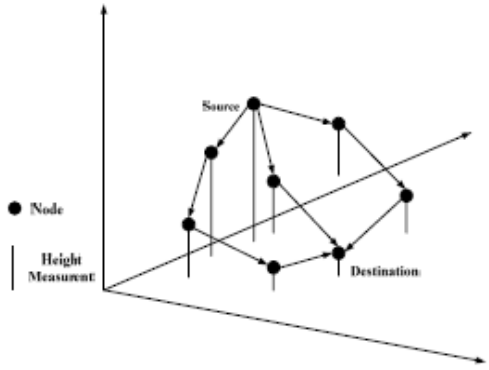

Figure 1: Design Concept of TORA

III. RELATED WORK

In [1], Binary Particle Swarm Optimization (BPSO) is used to improve TORA and present a new routing protocol called IMP-TORA. Two main elements of BPSO must be specified: the particle and the fitness function. The node that runs the routing algorithm as particle and a neighbor node that is selected as next hop in the route as Particle position. By using above descriptions, with start from source node until destination node, in each node i in neighbors of the current node, first calculate fitness of node I and update pbest's position, then we calculate velocity of node I. The node with highest velocity. Finally in neighbors of current node.

In [8], An EDTORA (Energy and Delay) was proposed, where energy and delay verification of query packet is done at each node. The energy extension indicates the minimum energy required to be available on the entire path between the source and destination. The delay extension gives the maximum delay allowed between source and destination.

In [5], Mobile relays are used to avoid the energy depletion problem due to excessive energy consumption at a higher rate. The residual energy of node and the rate of energy consumption are considered for early detection of energy depletion problem of node.

IV. ENERGY AWARE TORA PROTOCOL

When the source and destination are not within the direct range of each other intermediate nodes are used as a relay to forward the packets. While TORA creates multiple routes from source to destination it always selects the shortest path to forward the packet from source to destination. On selecting the shortest path there are chances that some nodes get overused and there battery gets depleted very soon because of which the nodes become dead. When any vital node becomes dead it affects the overall performance of the network. It can lead to network partitioning and decrease the lifetime of network.
The Energy Aware TORA routing protocol use the node to forward the packet only up to the time when the node has sufficient amount of energy. Once the energy of node becomes below the specified energy level then that node will not be selected in forwarding the packet and a new path will be selected in which all the nodes have energy above the threshold level. This will help in equal utilization of each node and prevent from overuse of any specific node. By making the nodes energy aware we can increase the lifetime of the network.

Proposed Algorithm

- Create route for data transfer by route creation process.
- Select one route for transfer
- Compute energy required in transmission and receiving of packet.

if (energy of node > required energy) then
if(energy of node < threshold energy) than
set status of node as sleep
find out neighbour having minimum nonnull height
create a new route
else decrement energy as
Energy_ = energy – required energy
if (energy_ = 0) then
Create a new route

IV. SIMULATION ENVIRONMENT

The simulation was performed in NS-2 [2], [6] under the Linux environment. A new approach was applied in TORA protocol to make it energy aware, the threshold value is assigned and before selecting the node to forward the packet it must have energy above this threshold value.

TABLE 5.1
SIMULATION PARAMETERS

Simulation time	400s
Topology size	800m*800m
Number of Nodes	8
MAC Type	MAC 802.11
Radio Propagation Model	Two Ray Model
Radio Propagation Range	250 m
Initial Energy	40J
Traffic type	CBR
CBR packet size	512 bytes

The performance metric are used to compare performance of TORA, EDTORA and Energy Aware TORA protocol.

1. Packet Delivery Ratio: The ratio of number of packets received at the destination and the number of packets transmitted by source.
2. Energy consumption of nodes during simulation in receiving and forwarding packets.

A. Simulation Results

The results are compared by generating the graphs of comparison using the xgraph.

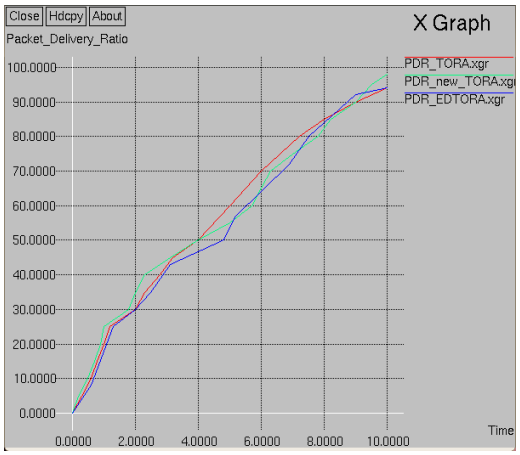

Figure 2. Comparison of Packet delivery Ratio Vs Time

In Figure 2. The red line shows the Packet Delivery Ratio in TORA Protocol and green line shows the Packet Delivery Ratio in Energy Aware TORA protocol and blue line shows the Packet Delivery ratio in EDTORA. It shows that Packet Delivery Ratio is better for Energy Aware TORA protocol as compared to TORA Protocol and EDTORA protocol.

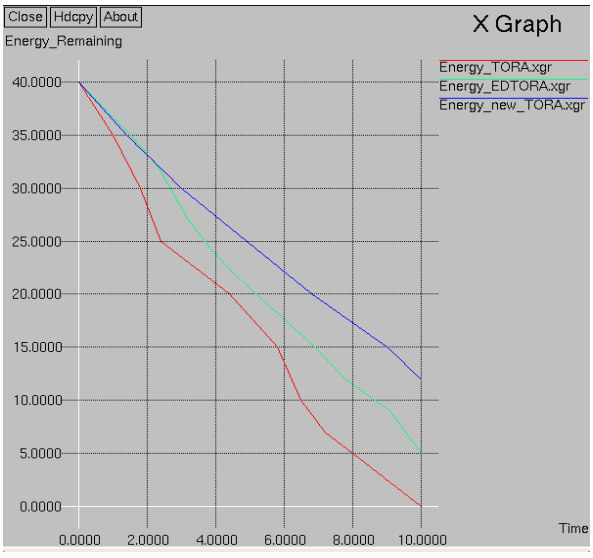

Figure 3. Comparison of Energy Consumption Vs Time

In Figure 3. The red line sows the energy Consumption in TORA Protocol and green line shows the energy consumption in EDTORA protocol,

Blue line shows the Energy Consumption in Energy Aware TORA protocol. It shows that TORA Protocol consumes more energy than Energy Aware TORA protocol.

V. CONCLUSION

In this study we have proposed a new approach of making TORA protocol Energy Aware by making simple modifications in it. The concept was to let the protocol make route through only that nodes which have energy above some threshold level, this makes the balanced energy consumption of all nodes and increase the network lifetime. After performing the simulation and comparing the results, we found that the proposed Energy Aware TORA has a good performance over the TORA and EDTORA protocol in terms of packet delivery ratio and energy consumption of nodes. In terms of energy consumption, TORA protocol consumes the energy of all nodes ie there is 0% of residual energy remains in node, in case of EDTORA protocol 12.5% of energy remains, whereas in case of Energy Aware TORA protocol as we have defined the Threshold value for all nodes, 32.5% of energy remains in all node. In terms of Packet Deliver Ratio, TORA and EDTORA protocol was having the packet delivery ratio as 93%, whereas in case of energy Aware TORA protocol this has increased to 97%, thus we have got 4% increase in packet delivery ratio.

VI. FUTURE WORK

In future we would like to include the power saving method, in which the nodes save their energy, when they are in idle state go to sleep state, so that their energy is not wasted in unnecessary searching of route, and they wake up when they have to forward the packets. This method also helps in saving the energy of node making it more energy efficient Mobile Adhoc networks includes many protocols, we would like to apply the energy parameter in other protocols also and check the result.

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