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Energy Efficient Multi-Path Routing In MANET's Using Swapping of Nodes and by Load Balancing of Data Packets onto the Nodes

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***Abstract*— To carry multiple routing in a mobile Ad-hoc network (MANET's) in order to make nodes more energy efficient by balancing the load onto node. Swapping of nodes is performed in order to make network more reliable, as the battery life duration of node increases. Here best fit function will be used in order to carry out swapping of two perfectly suitable nodes. System initially generates self-configuring network, which contained mobile nodes without any fixed infrastructure. After generating the network, multi-path source and destination is selected for sending the data. After that multi-path is found for sending the data, shortest path is found on the basis of energy of nodes and distance of nodes. After that energy consumption of each node is calculated, the node with low energy level are swapped using the swapping algorithm to the node with high energy level and data is send to the destination node. The greater the load onto the destination node more is the battery consumption. Thus to avoid the battery failure of node and to avoid more energy consumption, priority scheduling is used for data packet transmission.**

Keywords: *Wireless Sensor Networks, Sensor Nodes, Energy Efficient, Multipath Routing.*

I INTRODUCTION

In recent years Wireless sensor networks (WSNs) has been many uses in tracking and monitoring, where they have attracted more attention. The utilizations of WSN into industrial, biomedical, ecological, military, agrarian, local, and business fields are increased. Mobile ad-hoc network is a part of wireless sensor networks where the sensor nodes are mobile. These networks basically comprise of two types of mobility, one is automatic mobile network and the other one is manually operated mobile networks. One of the examples of automatic MANET is the tactical MANET which is widely used in modern military units, especially for the autonomous manoeuvring of unmanned vehicles and robots [10] .

An ad-hoc network is a group of wireless mobile nodes in which nodes collaborate by forwarding packets for each other and allow them to communicate outside the direct wireless range [8]. The participating nodes act as router and are free to move in network randomly and manage themselves arbitrarily. The network's wireless topology may change rapidly and unpredictably. The mobile nodes are operated by using limited energy battery and usually it is impossible to recharge or replace the batteries in a remote area. The wireless communications consume significant amount of battery power [1]. Routing is a process of detecting various routes from source to destination nodes. All the routes are calculated and then restored in network. Routing tables are of two types Static Routing and Dynamic Routing. Static routing is a type of network routing technique and dynamic routing is a networking technique that provides optimal data routing. The routing table is not affected by addition or deletions of router in case of static routing but it is affected in dynamic routing. Changing the positions of nodes [3] and connections, the energy and lifetime of network degrades.

In this paper we study about Literature Review, in section II, the proposed approach modules description, mathematical modeling, algorithm and experimental setup in section III .and at final we provide a conclusion in section IV.

II LITERATURE REVIEW

In [1] this paper they develop optimal energy technique for ad hoc networks (MANET). For this they considered four elements namely transmission power, interferences, link lifetime, and load balance. A load balance approach are using for the distributing traffic over the available routes to addressing problem in traffic congestion and choosing a minimal power route. For this load balancing and optimal energy they using algorithm known as OELR.

In [2] major problem in ad hoc networks are resource constraints in this paper propose techniques for transferring server load from the one server to another one server. Energy efficiency is the major problem in ad hoc networks. In this they purpose algorithm for diverting the load from low energy node to the high energy load by using multipath routing techniques.
Bhavna Sharma and ShailaChugh [3] are purpose load balancing, energy conservation, and shortest path techniques for routing a packet. For the energy conserving those using energy based multipath routing (E- AOMDV) schema. The life times of proposed E-AOMDV are limited but the improved routing as compare to AOMDV without including the energy factor.

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Jiangtao Yin, Xudong Yang [4], they presents a priority queue scheduling algorithm named as energy-efficient and load balanced queue scheduling algorithm (ELQS) for Mobile Ad Hoc Network (MANET. For reducing heavy traffic load they are considered parameter such as capacity cost, a function of one mobile node's congestion level and energy usage, and it is divided into three different phases Min and Max two thresholds. Results are show that ELQS decrease the network transmission delay.

Xiaoying Zhang and AlaganAnpalagan [5], they propose energy-aware load-balanced routing (EALB) algorithm for increasing packet delivery ratio. And it reduces the delay and prolongs the network lifetime in heavy load networks. EALB achieves higher PDR, lower delay and longer network lifetime than traditional AODV and DSR in the network with heavy traffic load.

MANET (Mobile Ad-hoc Networks) is useful in many practical scenarios since it provides multi-hop communication without wired infrastructure. However, there is a problem that the communication performance of a flow may be easily degraded by even a single local congestion on the whole path. A solution for the problem is to use a detour path that avoids the local congestion. However, to this end, the detour paths should not use the nodes in the congested area, which is in fact relatively large due to the nature of radio waves. In the current state of the art, we do not have such alternative-path computation algorithms. In this paper, we propose an algorithm and a routing scheme to compute and utilize detour paths adaptively according to the network traffic conditions. Through evaluation, we show that the proposed scheme improve the communication performance by using the detour paths in practical network scenarios [6].

In [7] designed a new algorithm using the combination of Ad-hoc on Demand Distance Vector (AODV) and Cross layer design approach. It is referred as Congestion Control AODV (CCAODV) approach. It is used to avoid link break in MANET. Received signal strength is used as cross layer design parameter. The CCAODV protocol creates strong and stable route by using signal strength of node. The signal strength mainly depends on the parameters like transmission power of node and distance between two nodes. The cross layer design approach is tested by using Ns 2.35 simulator and compared with the AODV routing protocol.

Wireless Sensor technology is one among the fast emerging technologies in the current scenario and it has wide range of application also which has small sensors with minimum communicational and computational power. Depending on the overhead of a node, the energy consumption varies with each other. This leads to the nonniform distribution of the energy which in turn degrades the performance of the whole network. Swap Rate algorithm (SRA) is used for detecting the low level energy node. In addition, the nodes are detected even during the other network interruptions. In the recovery method, the node in its vicinity will detect the low level energy node position and it will update to sink node which in turn sends nearby node that has good energy level to recover the node. It will replace the node and finally the data transmission will be taking place without any obstacles to achieve the reliability in the network [8]

In paper [9] ,for unmanned autonomous maneuver network author present architecture of the MACand Network layers of tactical MANET. It provides the multi hop ad hoc network.

III PROPOSED APPROACH

A. Proposed System Overview

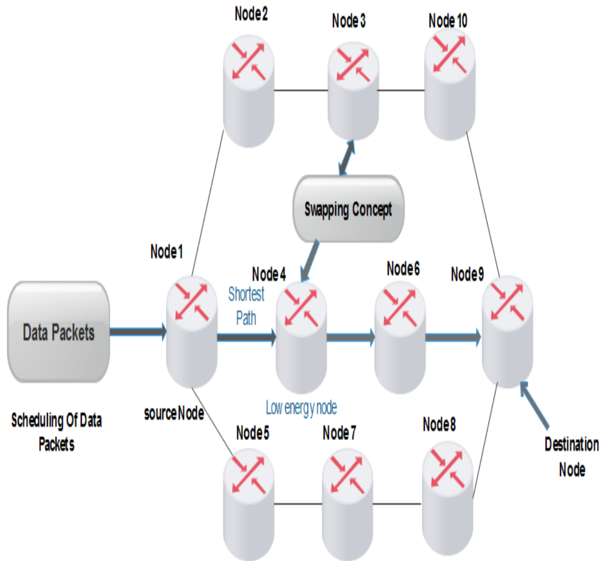

Figure 1 System Architetcure

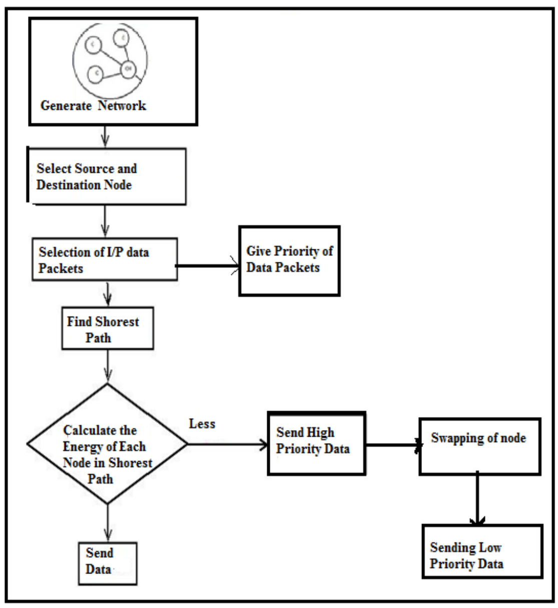

Figure 2 System design

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Techniques used to implement this system:

1. Network Generation

Initially random network is generated; node position in random network is not fixed.

2. Select Source and Destination Node

Network creation the selection of source node and destination node.

3. Find the Path

Depend on the source node and destination node generates the multiple paths from source node to destination node.

4. Search Shortest Path

Next step is to search the shortest path among the multiple paths to send data.

5. Energy Value Calculation

After finding shortest path calculate the energy of each node of shortest path, if node energy is sufficient to data transfer then data transfer from source to destination here for this use low priority data and high priority data

6. Swapping of Node

If node energy is not sufficient to data transfer then checks the neighbor path node energy, if there is sufficient energy to data transfer then swapping of node is perform.

7. Send Data

After selecting the shortest path with energy efficient node then send the data from source node to destination node.

B. Algorithm

a) Algorithm 1: Multipath Route energy base route for Load Balancing Algorithm

1. Set M Mobile Node's
2. Set S sender and R receiver Node
3. Set Initial Energy = E // *for all node energy is different value*
4. Broadcast Route

{

If (route from S to R found)

{

Check High Priority Route;

If (route => 1)

{Find (energy of each route && energy > 0)

Select High Priority Route //*shortest path*

Send high priority data

}

}

Else {route unreachable}

}

5. Send data through selected path

C. Mathematical Model

Input - Wireless Link Model with N number of nodes.

Output- Energy efficient and load balancing network

Process 1:

Calculate capacity of wireless link

$c(l) = W(l) \log_2(1+ \ (l))$

where,

w(l)= Channel bandwidth at link l

$\theta(l)$=SINR

$$\theta(l) = \frac{G(T(l), R(l)P(l))}{\sigma_{R(l)} + \sum_{m:m\neq l} P(m)G(T(m), R(l))}$$

$\sigma_{R(l)} = \sigma_{R(l)}$=P(l) =transmission power at node T(l),

G(T(l),R(l)) =path gain between the transmitter and receiver

Process 2:

Find Path:

1) Dijkstra():

create vertex set Q

for each vertex v in Graph:

dist[v] ← INFINITY Unknown distance from source to v

prev[v] ← UNDEFINED Previous node in optimal path from source

addv to QAll nodes initially in Q (unvisited nodes)

dist[source] ← 0 Distance from source to source

whileQ is not empty:

u ← vertex in Q with min dist[u] Node with the least distance will be selected first

removeu from Q

for each neighbor v of u: where v is still in Q.

alt ← dist[u] + length(u, v)

ifalt<dist[v]: A shorter path to v has been found

dist[v] ← alt

prev[v] ← u

returndist[], prev[]

2) By using Dijkstra's algorithm + Energy factor

d(S,R)=v from S to R with minimum distance and $v \in V$and P(l) is high.

S=Sender

R=Receiver

v=vector

V=all vector in graph

Process 3:

Calculate transmission power

$P=(P(l)................P(L))^T$

P= power vector i.e transmission power for each link

L=number of links in the network.

Process 4:

$P \geq FP + b$

where FP= Interaction power vector

b=bandwidth is $(b(l)..........b(l))^T$

Process 5:

Mobility factor:

$$V = \frac{d}{Time}$$

$MF=P(mV)^2$

m= Mass

V=Velocity

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P_r=Power required for mobility at time T to V.

Process 6:

Load Balancing:

- Send high priority data.

RET=min(LET_i,s...........LET_{jin})

S= Source path P

i={i,i_2.........i_n} Set of upstream to node j

RET= Active path that j support during time period P.

- Low priority data

Calculate number of active path for any node$j+1 \in P$

$$RET_{j+1} = \max\{N^{act\,P} \times \frac{RET_{j+1}}{RET_i}, N_{j+1}^{act\,P}\}$$

$N_{j+1}^{act\,P}$= Number of active node with power vector

Success: $0 \le P \le P^{max}(l)$

Failure: $P > P^{max}(l)$

D. Algorithm

1) Deployments of nodes N(n).
2) Select source S(n) to destination node d(n)
3) Select i/p data packets DP(n)
4) Give priority to data packets DPH(n), DPL(n)
DPH(n)= High priority to data packets
DPH(n)=Low priority to data packets
5) Find the shortest path from multiple path
SP(n);
6) calculate threshold energy ET(n) to send data to next instant.
ET(n)=Distance/Energy =D/E(n)
7)If node energy E(n) =ET(n)
Data packet send to destination
else
find the neighbor high energy node EN(n)
8) high priority data packets DPH(n) send through Existing path i.e shortest path.
9) Swapping of node
E(n)=ET(n)
10) Low priority data DPL(n) send through nearest path except shortest path.

IV RESULT AND DISSCUSION

A. Experimental Setup

The system is built using Java framework on Windows platform. The Net beans IDE are used as a development tool. The system doesn't require any specific hardware to run; any standard machine is capable of running the application.

B. Expected Result

In this section we discussed about the energy consumption of the network for the proposed system and existing system. Energy of network is calculated as:

ETX (l, d) = ETX-elec (l) + ETX-amp (l, d) =

$$\begin{cases} E_{elec} * l + \varepsilon_{fs} d^2 * ld < d_0 \\ E_{elec} * l + \varepsilon_{amp} d^4 * ld < d_0 \end{cases}$$

In this section shows the energy calculation by using the above formula for different number of nodes. We plot graphs for all the different values shows in figure 3.

In this graph we are comparing energy consumed by each node which is in shortest path. As we can see from experiments the ADDV model consumes more energy. They can not consider the mobility of each node.

In swapping + Priority the energy consumption is low as we consider the mobility of node before replace the dead one.

Energy Required For Each Node Which Is In Shortest Path Is Compared

1. AODV2.Swapping +Priority Scheduling

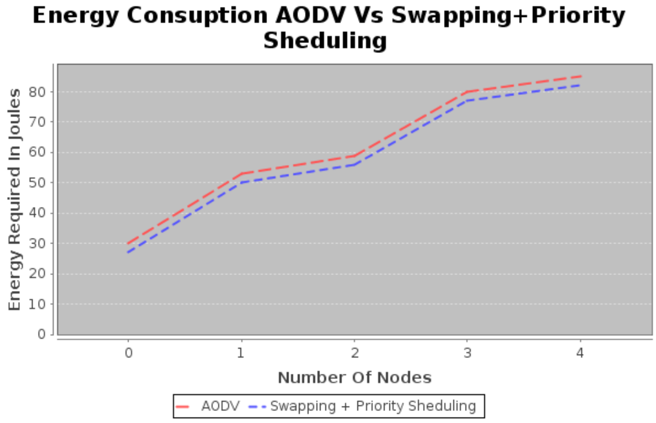

Figure 3: Energy Consumption Graph

Fig 4 Shows that Energy Graph For Only Swapping Of Node System. Proposed system are more accurated than the existing system.

In this graph we are showing the energy of each node. Whichnis in shortest path beforen data sending and after swapping + Priority data sending.

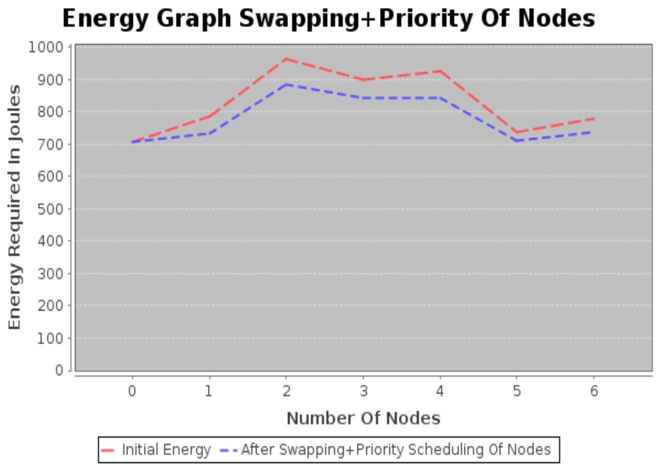

Figure 4. Energy Graph

From the experiment as we can see we consider the distance + Mobility + data size, the energy consuption is less,

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there is no wastage of energy by swapping with high power node which is for away from the destination.

1.Initial Energy- Starting Enegy Of Node

2. End Energy- Remaining Energy

Fig 5 Shows that Time graph. Proposed system are more accurated than the existing system.

In this graph we compare the time required for AODV and swapping + Priority system. From the experiment we can see that ,time consume by the swappingn+ Priority scheduling is less than AODV. The selection od node to swap the dead node is not effective in AODV it consumes time to search high energy node amongst all node and replace them.

The swappping + Priority check only nearest node to dead node and swapping it. The distance is low then time require to swappping less and not checking energy with all nodes. so time require for checking threshould is less

Time Required For Total Data Sending Is Comapred

1.AODV

2.Swapping +Priority Sheduling

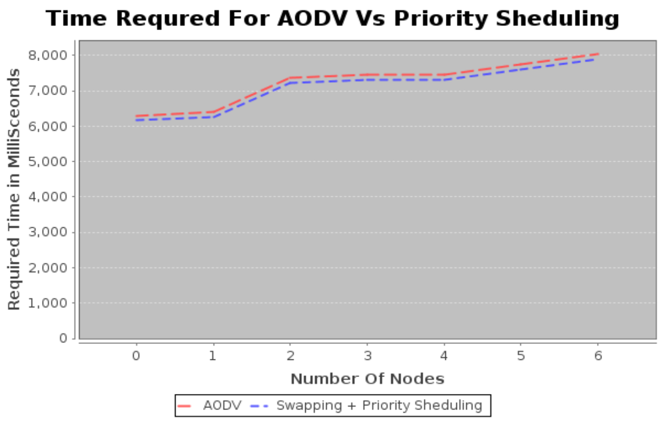

Figure 5 Time graph

V CONCLUSION

The proposed method helps to increases the network lifetime of the wireless sensor network also introduced the method Swapping and priority Scheduling, from which the network consumes less energy and increase the network lifetime and packet delivery ratio of the wireless sensor network. If the load is properly distributed then, in that case energy utilization increases and high priority data send.

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