PERFORMANCE ANALYSIS OF MTPR ROUTING PROTOCOL IN POWER DEFICIENT NODE

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ABSTRACT

Power conservation in Mobile Ad hoc Network (MANET) is a major challenge even today for researchers. To conserve it various power aware routing protocols have been proposed. These protocols do not take into consideration the residual power left in nodes. To find the impact of the same a simulator was designed in MATLAB-7.01. The routing protocol used in our simulation is Minimum Total Power Routing (MTPR) and different performance metrics such as path optimality, throughput and hop count were recorded in presence and absence of power scarce node. The result shows significant impact of power scarce node on MANET performance.

KEYWORDS

Ad-hoc Networks, MANET, Network Protocols, MTPR.

1. INTRODUCTION

A MANET (Mobile ad hoc network) is multi-hop wireless network that consists of mobile nodes that communicate via direct path or multi-hop wireless links in the absence of fixed infrastructure [1,2,5]. Mobile Ad-hoc network is multi hop wireless network that are communicate between two mobile nodes treated as indistinguishable no matter what is the distance between these nodes. Energy conservation is the most important issues in ad hoc networks The nodes of these networks have several constraints such as limited bandwidth, transmission range and processing capability due to which the network working has to be fully decentralized i.e. message processing or message passing must be done by nodes themselves using certain protocols [3,4].

MANET [6] is to be use in a lot of practical applications, including personal area networks, (PAN) home area networking, military environments, and search a rescue operations. The wide range of applications has led to a recent rise in research work and development activities. Efficient energy conservation plays an important role in the performance of MANET routing because mobile host in such networks are usually battery-operated [7]. Recently, some of energy efficient routings have been proposed, but most of them consider energy conservation in a static or relative static state. This work coordinated considers the stability of link and remaining power of node to be utilized.

Each node in MANET utilizes its limited residual battery power for its network operations. Therefore conservation of battery power is a crucial aspect for researchers in MANET. Several

DOI : 10.5121/ijans.2012.2407

researchers even today are working in this direction to conserve battery. Several mechanisms have been proposed to conserve battery power such as utilising variable transmission range of radios, minimising the number of hello broadcasts packets. In addition to it research area on conserving battery power using routing schemes is still going on. Various power aware routing protocols that are used for to extending the battery lifetime such as Minimum Total Power Routing Protocol (MTPR) Minimum Battery Cost Routing Protocol [MBCR], Power-Aware Source Routing Protocol, Localized Energy Aware Routing Protocol, Online Power Aware Routing protocol, Power Aware Localized Routing protocol and Power Aware Routing Protocol [8,9,10,13].

This paper considers MTPR routing protocol and tries to avoid those nodes whose residual energy is too low. In addition we are trying to compares the performance of both these protocols on various performance metrics such as hop count, throughput, path optimality etc. The result shows a impact variations or improvement when nodes with residual low energy are avoided from path [11].

The rest of the paper is organized as follows: section 2 explains overview of MTPR power aware routing for MANETs. Section 3 presents simulation based results, evaluation and performance comparison graphs of our work. Finally, conclusion and future work are presented in section 4.

3. MINIMUM TOTAL TRANSMISSION POWER ROUTING (MTPR)

MTPR tries to select a path that has minimum total transmission power. A node that requires a path to a distant node broadcast RREQ to all its neighbours. This process continues at each and every intermediate nodes till the packet reaches to a destination node. The diagram of routing protocol is given below;

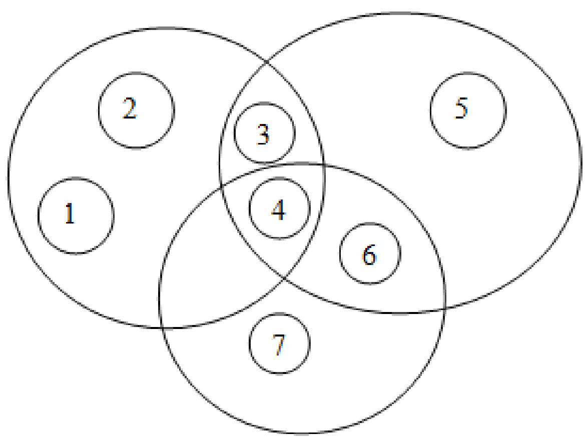

Figure 1. Diagram of routing protocol

The destination node receives RREQs from various nodes but selects the path with minimum total transmission power. It should be noted here that the total transmission power scales with transmitted distance as d^2 to d^4 depending on environmental conditions. This routing approach will in most cases tend to select routes with more hops than others [12,13].

The above protocol can made clearer with the help of an example network as shown in Figure 2. The distances between various pairs of nodes are shown in path matrix (see Table-1). Let us suppose 1 as the source and 7 as the destination. The paths selected from source to destination may be as follows:

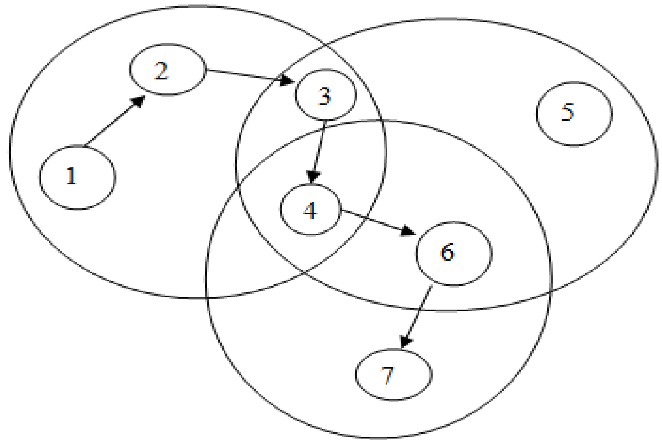

Figure .2 Packet move from source node 1 to destination node 7 using MTPR

- The path (1-2-3-4-6-7) has total transmission loss = k(15 * 15 + 10 * 10 + 10 * 10 + 5 * 5 + 10 *10)=550k units (Here total transmission loss is taken as kd2).
- The paths (1-3-4-6-7) has total transmission loss = k(20 * 20 + 10 * 10 + 5 * 5 + 10 * 10) = 625k.
- Similarly total transmission power loss in path (1-4-6-7) = k (2 5* 25 + 5 * 5 + 10 * 10) = 750k.

The path (1-2-3-4-6-7) has minimum total transmission power loss. Therefore the same is selected as shown in Figure 1. The limitations of this approach can be summarised as under:

1. The network will be congested as the packets has to routed from multiple nodes
2. More number of nodes has to participate in forming a routing path
3. It will always select its nearest neighbouring node.

Table 1: Path Matrix

Node →	1	2	3	4	5	6	7
	Distance between Nodes						
1	0	15	20	25	----	----	----
2	15	0	10	20	----	----	----
3	----	----	----	10	----	----	----
4	----	----	----	----	----	----	----
5	----	----	----	----	----	----	----
6	----	----	----	----	----	----	10
7	----	----	----	----	----	----	----

Table 1. shows the path matrix of source node to destination nodes with distance between them.

Our aim is to use MTPR routing strategy and to calculate its efficiency in presence of nodes which have lesser residual battery power. The idea behind this is to present a study which will encourage researchers to work on routing protocols based on concentration of energy deficient nodes.

3. SIMULATION AND RESULTS

A simulator was designed and implemented in MATLAB 7.0.1 in which an area of 1500 sq. unit's size was chosen. The randomly nodes were distributed using the function randint() in MATLAB 7.0.1.

Table 2 : Simulation set up parameters

Parameter	**Value**
Routing Protocol used	MTPR
Transmission Range	320 units
Number of Nodes	40
Nodes Placement Strategy	Random
Number of iteration	25
Percentage of nodes	0 to 100% step size of 10 %

One routing strategies named as Minimum Total Power Routing (MTPR) was implemented using Dijkstra's shortest path algorithm. Table 2 provides the simulation parameters to be used.

3.1. Metrics Used under consideration:

The metric used for the performance evaluation are as follows:

MTPR_Hop Count: Defined as number of at the instance of path formation by route from source to destination for successful transmissions.

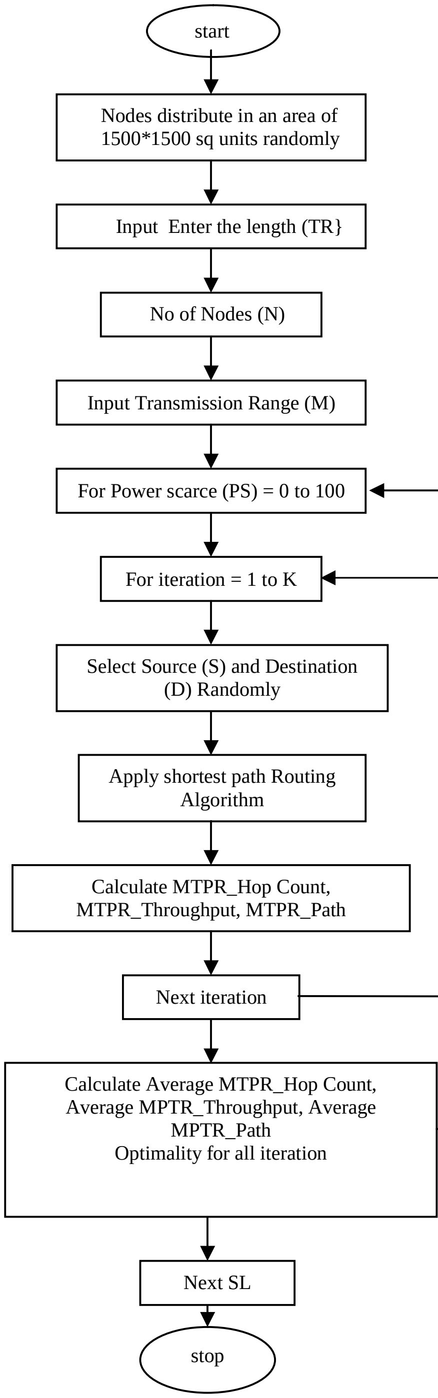

Figure 3. flow chart for simulator

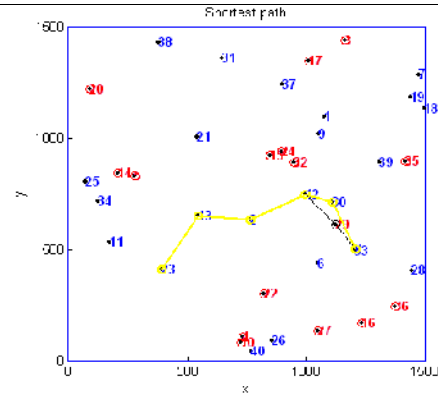

Figure 4. Snapshot to study the effect of MTPR_Path Optimality

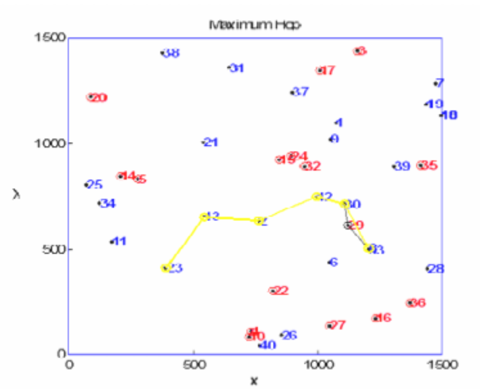

Figure 5. Snapshot to study the effect of MTPR_Throughput

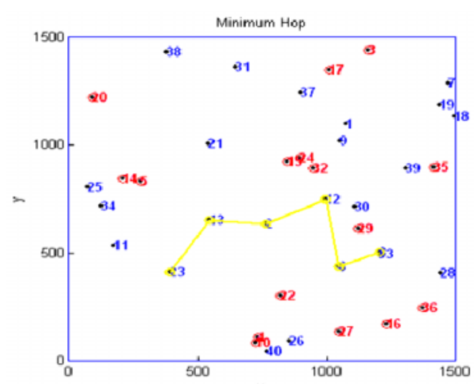

Figure 6. Snapshot to study the effect of MTPR_Hop Count

MTPR_Throughput: Defined as number successful data packets received at receiver to the total no of data packets sent by transmitter. Higher value of the throughput indicates higher stability of the route.

MTPR_Path Optimality: Defined as ratio of path length under presence realistic environment and absence idealistic environment.

3.2. Snapshot of the Simulator:

The Figures 3-6 show the snapshot of simulation process. Fig, 4 shows that the yellow line in the figures shows the path created by using MTPR routing protocol algorithms. The path distance measure the impact of transmission data range to be varied the network performance, and more energy can be consumed for a route and then calculated by taking fixed and variable transmission range of data nodes.

Shortest path when no node is performed and the black lines shows the shortest path after the avoidance of deficient nodes. At low concentration of deficient nodes it is more likely yellow and black lines will be same and as the concentration increases they are likely to be different. Thus at 0-10% concentration of data nodes are deficient nodes that the route found between a pair of source and destination of data is shortest and at k% concentration the route found is shortest as if no deficient nodes were present. Thus with the increase in concentration of deficient nodes.

3.2.1 IMPACT ON MTPR_THROUGHPUT

The successful average rate of data packets received at its destination where it may be transported over a certain network node. Throughput intermittently as data packets per second. Here in this study as shown in Figure 7 the throughput rate maximum value when 40% then decrease from 40% proportionate to decreasing percentage level 0 with 96%.packets dropped.

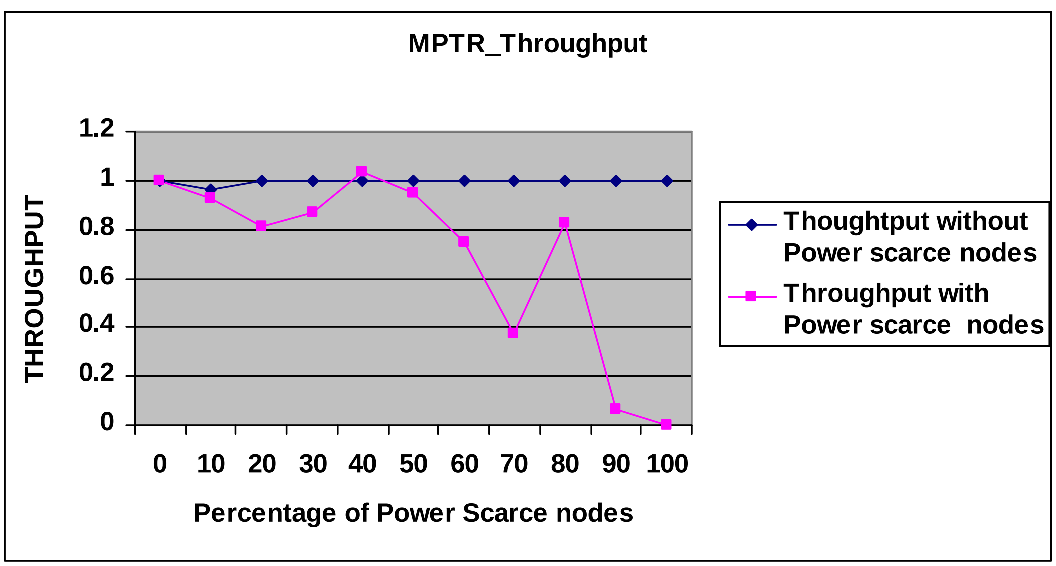

Figure 7. MPTR_Throughput V/s with or without Power scarce

3.2.2 IMPACT ON MTPR_ HOP COUNT:

Figure 8. Shows the impact of increase in hop count as the concentration of power scarce nodes increases. The average MTPR_HOP count is almost same when the deficient nodes are up to 10% of the total number of nodes. The maximum hop count occurs at 50%. The average hop count slightly decreases up to 72% and 0 when it reaches 96.5 %. If the route formation does not occur, then in that the maximum hop count was taken.

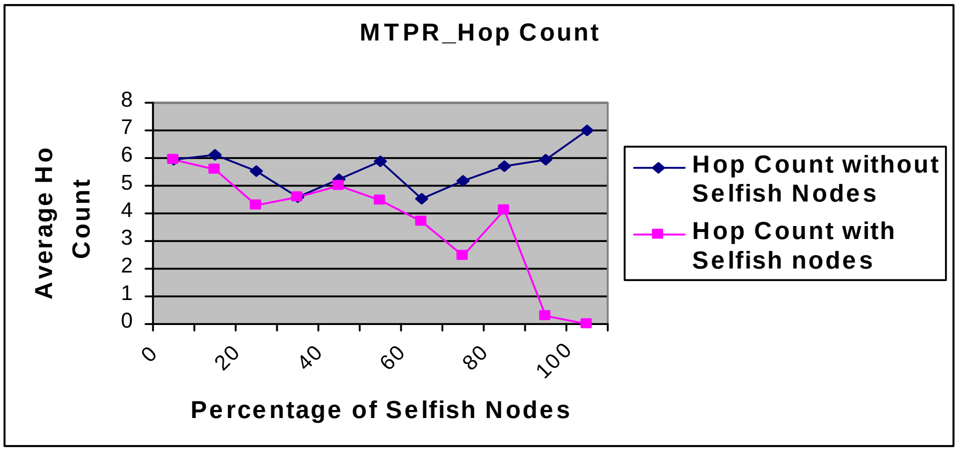

Figure 8. MPTR_Hop Count V/s with or without power scarce

3.2.3 IMPACT ON MTPR_ PATH OPTIMALITY

Figure. 9 shows the impact of simulation of path optimality of deficient nodes path length on the percentage of packets dropped. There is no significant change in the percentage packet dropped when the deficient node concentration is up to 15%. It reaches to a maximum value of nearly 45% then the deficient node decreasing percentage level 0 with 98.9% packet droped.

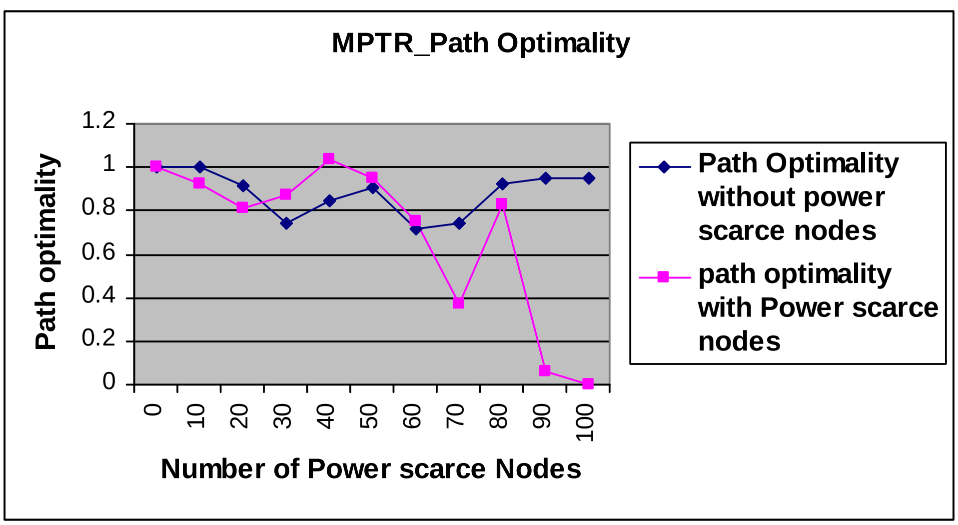

Figure 9. MPTR_Path Optimality vs with or without Power scarce

4. CONCLUSION & FUTURE SCOPE

The problem of power scarce nodes is very common in ad hoc networks. The major reason for it is cooperation among nodes in routing data packets. As the time passes away the nodes loose their battery power .The effect of environment is also pronounced. The following inference can be made from above results as follows:

- There is almost 45.6% decrease in values of hop count, throughput, and path optimality in the presence and absence of power scarce nodes.
- Nearly 10%, power scarce nodes do not have any negative effect on the network activities.
- The network never comes to halt position where as the power scarce node reaches to nearly 97.6%.

The average hop count reaches to a maximum 3.4 times, Probability of percentage of power scarce nodes and throughput comes down to nearly 45% at its peek and percentage of packet drop goes up to nearly 55% at the most.

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