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# Priority Based Routing in Mobile Ad-hoc

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**Abstract**— A mobile Ad hoc network is a collection of wireless mobile nodes forming a network without using any existing infrastructure. All mobile nodes function as mobile routers that discover and maintain routes to other mobile nodes of the network and can be connected dynamically in an arbitrary manner [3]. Instead of just communicating based on the availability of power, we would implement the priority calculation algorithm in the eventual steps so as to protect the network breach as well as obtain the communication system of desired feature. Once a network has been constructed, we would not again send data packets through the same sequence of nodes in successive iterations. This would, to some extent eliminate predictability of the path of communication. Hence, we would consider the factors like the power of node, time taken for communication, interference rate for communicating node as well as attack possibility on it.

**Index Terms**—Ad-hoc, Attack Possibility, Interference rate, Node power, Predictability, Success rate, Computer Science, Mobile computing

## 1 INTRODUCTION

A Mobile Ad-hoc network (MANET) is an infrastructure less network where the nodes involved in it pertain dynamic positions at various time spans.[1] With the advancements in the mobile communication, the regular demands of the customer have rose. Not only network lifetime, but the security of communicating system from attacks, minimal interference from neighboring wireless components as well as the time consumed in the communication between the intermediary nodes and eventually the time for the communication between source and destination nodes have now become the essential constraints put forward by the customers. Thus, it is suitable to address these requirements, which is tried by the proposal of this paper. Mobile nature of the participating nodes led to the employment of Ad-hoc on-demand Vector Routing (AODV).[4] Using this mechanism, the data packet is sent only to those nodes which respond to the listening packet sent by the source node.

Communication system in ad-hoc has advanced with years. It is better to manage its communication through the prioritized requirements [2],[8]. This would eventually manage the transmission according to its priority list. For example: if an organization gives highest priority to the network lifetime, it would provide its specification accordingly such that the con

stant related to network lifetime would pertain highest value amongst the available sets of the constants. In the past, either power of the participating mobile nodes or the cost involved was taken as major constraint in establishing the network. We, through this paper, shall provide additional impetus to bring out even more advancements upon those technologies. The power-routing and cost-routing algorithms [7],[10]merely consider the power available in the node or the node's lifetime and the costs involved in the networking respectively. But, the intent of the proposal presented by this paper is to institutionalize these factors as well as the two others i.e. Interference factor and Attack possibility on the commu

nicating system so as to meet the specific needs of the specified implementable scenario.

A basic concern is about the predictability of the path in the communication [11]. It is possible for an intruder to analyze the traffic flow and encroach into the communicating system. Thus, it is proposed that the nodes would not follow the same path for data flow once it has been traversed in the previous iteration of transmission. This would certainly bring out the property of unpredictability in the flow of data packets. Also, if no other paths than the prior iteration's path is possible, the system would finally follow the same.

Two main phases are involved in MANETs viz. Route Discovery and Route Maintenance. Route discovery refers to identifying the appropriate path for data transmission between the two nodes.[4] For this , the algorithm presented in the paper employs above mentioned constraints so that the requirements

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of the customers/users are satisfied. In the route maintenance phase, the source continually monitors the position of the nodes to make sure that the data is being carried through the path to destination without loss [4].

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## 2 Procedure for Paper Submission

### 2.1 Constraintless Power and Cost aware Routing Algorithm

The optimum power and cost optimization algorithm proposed by [1] is taken as a base for our proposed algorithm. The algorithm abolished the usage of the constraints like threshold and cutoff values and obtained the power and cost optimal communication scenario in ad-hoc network.

```
Algorithm power-cost-optimal
 {
 reply->value:=0; //For delivery failure.
 S:=source(A);
 /*Now, eliminate source as neighbor to any other node*/
send(listening-packet);
 reply:=node-algorithm();
 if(multiple relies)
 {
 reply:=reply(of node which has minimal routing distance i.e.|AB|);
 if(minimal distance same for multiple nodes)
reply:=reply(of node having highest battery power);
}
if(reply->value)
send(reply->address);
else Delivery failure or destination reached;
}
```

The node algorithm is used in each of the nodes, so as to obtain the comparison of the power or battery lifetime of each node with the amount of energy required in sending the defined packet towards the neighboring node. Also, this algorithm determines the least cost and more power efficient path for the transmission of the packet when two or more paths are available.

```
 Algorithm node-algorithm(B)
{
 //Initially all nodes have reply->value==0
if(Destination reached)
{
 return(reply );
 stop the process;
}
 size:=listening-packet->size;
 while(power(B)>power-calc(B)
 {
 reply->value:=1;
 power-cost-optimal(B);
 }
 return(reply);
}
```

Feeney et al's formula for the measurement for energy consumption is utilized in the power-calc algorithm so as to determine the amount of energy required to receive and transmit the certain sized packet.[5],[9]

```
Algorithm power-calc(B)
 {
 return(m*size + b);
 }
```

### 2.2 The Density Based Flooding Algorithm

This algorithm is used to identify the density of the nodes in a cluster and eventually determine the interference caused by them[6].

1. The node n1 which starts the broadcast resolves it neighbors and updates it Neighbor count .n1 and marks it type as.
ß nodes ←n1 <= τ
a nodes ←n1 > τ
and then mark the message with its type and then broadcast it to all its neighbors which are listening at a specific port (by assuming p1 = 1.)The node will add that packet ID I0 in its 'Message Seen List' L1 to avoid forwarding it again.
2. On receiving a packet, a neighboring node will add that packet ID I0 in its 'Message Seen List" L2 and then update its Neighbor count n2 and marks its type using the condition (1)

if I0 ∉ L2 then
{
if ti != ß and tpi = α then
 if α< p2 then
Forward the Packet.
}
Else
Forward the Packet with probability 1.
}
Else
It is a previously seen message. So drop it
}

where ,
ti ← type of the current node
tpi ←type of the previous node
α←probability (randomly chosen between 0 and 1)
p2 = 1 /n1 * τ
p2 is the probability in which it should re-broadcast the packet. All the remaining nodes of the network will forward the packet based on the condition. This will stop until all the nodes of the network receive at least one copy of the packet with same ID I0.

## 3 Proposed Algorithm

We propose "***Priority Based Algorithm***" to determine the appropriate path for data transmission as follows:

i.) The reply would contain:

a. Power of node

b. Time of receipt

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c. Interference rate due to neighbor nodes

d. Amount of attacks

ii.) Interference rate is calculated by evaluating the density of the neighboring nodes and their signal strength. This value is eventually normalized in the range of [0,1].

iii.) Eventually employ the formula when two or more neighbors are capable of establishing a communicating system.

iv.) Add up to get maximum of the paths for each path, and employ formula as:

$$\Pr obability(P) = s(\alpha p - \beta t - \gamma i - \Omega a)$$

where,

s=success rate i.e. 0 or 1

p=power of node

t=time taken for nodal communication

i=interference for node by neighbors

a=attack possibility on node

$\alpha$, $\beta$, $\gamma$, $\Omega$ are user expected constraints which should fall in the range [0,1].

## 4 MATHEMATICAL SYNOPSIS

Above algorithm is employed to obtain the mathematical calculations as given below. For the values of the various constants employed in the formula we shall deploy the following tabulated values. The values are generated as random numbers i.e. 0.693, 0.066, 0.984, 0.479 and eventually used according to the ascending order for the priorities of the constants. We should take the priority order and value by using the **table 1.**

We have identified four possible scenarios in the communication viz.

i. Network lifetime sensitive communication

ii. Time sensitive communication

iii. Interference sensitive communication

iv. Attack sensitive communication

*i.Network lifetime sensitive communication:*

In the general communication scenarios, it is highly essential to maintain longer network lifetime. Thus at such cases the duration or lifetime of network becomes the most important criterion.

*ii. Time sensitive communication:*

In the emergency scenarios like natural calamities, accidents and many more, the time for communication plays vital role. At such instances the communication needs to be faster rather than having longer network lifetime.

*iii. Interference sensitive communication:*

Military and security related communications are sensitive enough to not be hampered by the neighboring signals. Thus it gives higher priority to the free transmission of the communicating signal.

*iv. Attack sensitive communication:*

Highly secured communication which would decrease the chances of the possible attacks and threats is desirable in the security related organizations like military, finance, etc.

**Table 1. Sample user defined priorities and corresponding values of the constants**.

| *For network lifetime sensitive communication* | | |
|---|---|---|
| Constant | Priority | Value |
| $\alpha$ | 1 | 0.984 |
| $\beta$ | 2 | 0.693 |
| $\gamma$ | 4 | 0.066 |
| $\Omega$ | 3 | 0.479 |
| *For time sensitive communication* | | |
| Constant | Priority | Value |
| $\alpha$ | 4 | 0.066 |
| $\beta$ | 1 | 0.984 |
| $\gamma$ | 3 | 0.479 |
| $\Omega$ | 2 | 0.693 |
| *For interference sensitive communication* | | |
| Constant | Priority | Value |
| $\alpha$ | 3 | 0.479 |
| $\beta$ | 4 | 0.066 |
| $\gamma$ | 1 | 0.984 |
| $\Omega$ | 2 | 0.693 |
| *For attack sensitive communication* | | |
| Constant | Priority | Value |
| $\alpha$ | 2 | 0.693 |
| $\beta$ | 3 | 0.479 |
| $\gamma$ | 4 | 0.066 |
| $\Omega$ | 1 | 0.984 |

### 4.1 Values Taken For the Respective Nodes

Eventually, we have taken a communication scenario having five nodes, where node 1 is the source node and node 2 is the destination. The values for the power of node, (p), the rate of interference, (i) and the possibility of attack, (a) for each of the nodes after their participation in the communication system are depicted below:

**Table 2. Obtained values for power of node, interference rate and attack possibility (normalized in [0,1]).**

| | Node | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| p | 0.00 | 0.90 | 0.70 | 0.60 | 0.70 |
| i | 0.00 | 0.60 | 0.35 | 0.82 | 0.20 |
| a | 0.00 | 0.40 | 0.72 | 0.19 | 0.80 |

The time required for the communication between the nodes is shown through a 5x5 square matrix:

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**Table 3.Time required for communication between two nodes.**

| Node | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 0.00 | 0.30 | 0.25 | 0.40 | 0.70 |
| 2 | 0.30 | 0.00 | 0.42 | 0.31 | 0.65 |
| 3 | 0.25 | 0.42 | 0.00 | 0.29 | 0.58 |
| 4 | 0.40 | 0.31 | 0.29 | 0.00 | 0.48 |
| 5 | 0.70 | 0.65 | 0.58 | 0.48 | 0.00 |

### 4.2 Calculation for Network Sensitive Communication

An assumption that all the neighboring nodes shall send the success value as 1 to the eventual source node of the iteration is made to proceed in the calculation.
Thus, we calculate the probability matrix as follows:
As node 1 is the source node, thus all the paths possible from it are evaluated for their corresponding probabilities:
p(1,2)=0.8856-0.2079-0.0396-0.1916=0.6381
p(1,3)=0.6888-0.17325-0.0231-0.34488=0.51555
p(1,4)=0.5904-0.2772-0.05412-0.09101=0.16807
Here, p(1,5) is not considered as we don't intend to directly establish the communication between the source and the destination.
Above p(1,2) has highest probability value thus next source shall be node 2.
p(2,1)=0 ,p(3,2)=0, p(4,2)=0, p(5,2)=0
And,
p(2,3)=0.02976, p(2,4)=0.23044, p(2,5)=-0.15805
Here p(2,4) has the highest value for probability thus node 2-4 is traversed. Eventually, p(3,4)=0 and p(5,4)=0.
p(4,3)=0.11985, p(4,5)=-0.04024
Thus path 4-3 is selected.
And, p(5,3)=0, p(3,5)=-0.10954
The tabulated form of these values is:

**Table 4. Calculated probability values**

| Node | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 0.00 | 0.638 | 0.515 | 0.168 | 0.00 |
| 2 | 0.00 | 0.00 | 0.029 | 0.230 | -0.158 |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | -0.109 |
| 4 | 0.00 | 0.00 | 0.169 | 0.00 | -0.040 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Thus, from the table we can obtain the possible paths with the sum total of the probability values as:
1-2-3-5: 0.55832
1-2-4-3-5: 0.87885
1-2-4-5: 0.8283
1-2-5: 0.48005
1-3-5: 0.40601
1-4-3-5: 0.17838
1-4-5: 0.12783
Finally, this proves the path 1-2-4-3-5 to have the largest sum for the probability values. Thus, it would be the optimal path as per our algorithm.
Using power calculation algorithm, the path followed by packet can be depicted as:

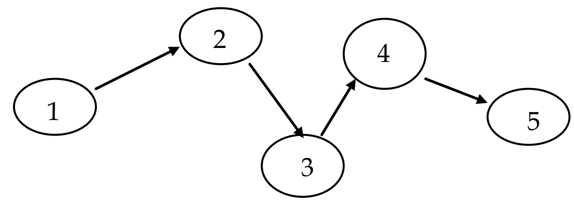


**Fig 1. Path followed as per Power Calculation Algorithm**

After using the priority based algorithm, the path will be traversed as:

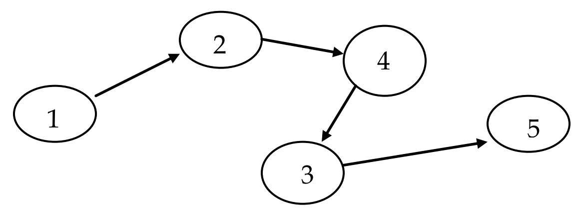


**Fig 2. Path followed as per Priority Based algorithm**

## 5 CONCLUSION

This paper presents the user defined factors like power of the node, time required for communication, rate of interference for each node and attack possibility on the corresponding node as the pivotal keys to construct the communication system in the mobile ad-hoc environment. It focuses on identifying the need of the various scenarios and implementing the communication system accordingly. In the end, we intend to propose a solution for need-based scene which would be both optimal and easily acceptable in the implementation scenario.

## 6 FUTURE WORKS

The paper can be extended to satisfy other user required constraints if any. This shall make the implementation of ad-hoc , application specific.

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