IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 20, Issue 6, Ver. I (Nov - Dec 2018), PP 65-71
www.iosrjournals.org

Self Repairing Of Routing In MANET Using Weight Factor

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Abstract: *The challenge of wireless communication is that, the environment that wireless communications travel through is unpredictable. Wireless networks that fix their own broken communication links may speed up their widespread acceptance. An effort has been made to propose an on-demand distributed algorithm for self-organizing, multihop, mobile packet radio large network. These nodes are independently controlled and are dynamically reconfigured as nodes may move from one range to another. It is seen that when the network size increases, per node throughput of an ad hoc network rapidly decreases. This is due to the fact that in large scale networks, flat structure of networks results in long hop paths which are prone to breaks. A weight factor has been added that will be broadcast to each node in the network. The proposed algorithm is robust due to the motion, failure, insertion or deletion of nodes. This non periodic algorithm reduces the cost due to computation and communication. Simulation experiments evaluate the performance of the proposed scheme.*
Keywords: *Mobile Ad Hoc networks, Self healing, Load balancing, Mobile computing, Routing*

I. Introduction

In developing broadband digital networks, a short service-outage such as a link failure or a node failure can cause a serious impairment of network services. It is due to the volume of network traffic carried by a single link or node. Moreover, the outage can stimulate end users to try to re-establish their connections within a short time. The retrials, however, make the problem worse because the connection establishment increases the traffic volume further. Fast restoration from a network failure becomes a critical issue in deploying high-speed networks. Self-healing algorithms have been recognized as a major mechanism for providing the fast restoration. A self-healing system [1,2,8] should recover from the abnormal state and return to the normal state, and should start functioning as it was prior to failure. One of the key issues associated with self-healing networks is to optimize the networks while expecting reasonable network failures [3,4,5,8]. Self-healing network (SHN) [6,8] is designed to support transmission of messages across multiple nodes while also protecting against recursive node and process failures. It will automatically recover itself after a failure occurs. The problem of self-healing is in networks that are reconfigurable in the sense that they can change their topology during an attack. One goal is to maintain connectivity in these networks [9], even in the presence of repeated adversarial node deletion. Modern computer systems are approaching scales of billions of components. Such systems are less akin to a traditional engineering enterprise such as a bridge, and more akin to a living organism in terms of complexity. A railway overbridge must be designed in such a way that, key components never fail, since there is no way for the bridge to automatically recover from system failure. In contrast, a living organism can not be designed so that no component ever fails: there are simply too many components. For example, skin can be cut and still heal. Unfortunately, current algorithms ensure robustness in computer networks through hardening individual components or, at best, adding lots of redundant components [7].

Critical issues [10] in self-healing systems typically include ; Maintenance of system health, recovery processes to return the state from an unhealthy state to a health one. Self-healing components or systems typically have the following characteristics [10] : (a) perform the productive operations of the system, (b) coordinate the activities of the different agents, (c) control and audit performance, (d) adapt to external and internal changes and (e) have policies to determine the overall purpose of the system. Most of the self-healing concepts are still in very early stages; still some possible areas explored are Grid computing, software agents, middleware computing, ad hoc networks. Emphasis here is on ad hoc network self healing characteristic.

A Mobile Ad Hoc Network, properly known as MANET [20] is a collection of mobile devices equipped with interfaces and networking capability. Hosts [19] can be mobile, standalone or networked. Such devices can communicate with another node within their radio range or one that is outside their range by multi hop techniques. An Ad Hoc Network is adaptive in nature and is self organizing. It is an autonomous system of mobile hosts which are free to move around randomly and organize themselves arbitrarily. In this environment network topology may change rapidly and unpredictably. The main characteristic of MANET strictly depends upon both wireless link nature and node mobility features. Basically this includes dynamic topology, bandwidth, energy constraints, security limitations and lack of infrastructure. MANET is viewed as suitable systems which can support some specific applications as virtual classrooms, military communications, emergency search and rescue operations, data acquisition in hostile environments, communications set up in exhibitions, conferences and meetings, in battle field among soldiers to coordinate defense or attack, at airport terminals for workers to share files etc.

In this paper an efficient weighted probabilistic algorithm for Mobile Ad Hoc network has been proposed to self heal, which considers the number of nodes in routing which can handle ideally, transmission power, mobility and battery power. The proposed algorithm selects a node with probabilistic weight considering effect of the three factors as Power factor, stable routing and backbone nodes on Ad Hoc networks. The rest of the paper is organized as: Section 2 presents a review of significant contribution in the area of routing for Ad Hoc networks and their limitations. In Section 3, the design philosophy and the Methodology of the routing scheme has been presented. Section 4 discusses the Simulation results and performance evaluation. Conclusions are given in the last section.

II. Routing

Routing protocol is needed whenever a packet needs to be handed over via several nodes to arrive at its destination. A routing protocol finds a route for packet delivery and delivers the packet to the correct destination. Routing Protocols have been an active area of research for many years; many protocols have been suggested keeping applications and type of network in view. Routing protocols can broadly classify into two types as (a) **Table Driven or Proactive Protocols:** here each node maintains one or more tables containing routing information to every other node in the network. All nodes keep on updating these tables to maintain latest view of the network. Some of the existing table driven or proactive protocols are: DSDV, GSR, WRP, ZRP and STAR. and (b) **On Demand or Reactive Protocols:** here routes are created as and when required. When a transmission occurs from source to destination, it invokes the route discovery procedure. The route remains valid till destination is achieved or until the route is no longer needed. Some of the existing on demand routing protocols are: DSR, DDR , TORA, AODV and RDMAR.

Study has been concentrated for reactive protocols because they work well in dynamic topology. Surveys of routing protocols for ad hoc networks have been discussed in [18,19,20].

III. Design Philosophy of a WNA

The objective of the proposed algorithm is to get a stable, power efficient protocol. To perform this role, however, a node does not require additional resources (e.g. buffers, processing power etc) since protocol support functions are well distributed among all nodes.

The network formed by the nodes and the links can be represented by an undirected graph $G = (V, E)$, where V represents the set of nodes v_i and E represents the set of links e_i. Note that the cardinality of V remains the same but the cardinality of E may change with the creation or deletion of links [5].

IV. Algorithm

To decide the probability of a node to participate in routing, four main factors as its degree, transmission power, mobility and battery power are taken into account. Unlike other existing algorithms which are invoked periodically resulting in high communication overhead, proposed algorithm is adaptively invoked based on the mobility and battery power consumption of the nodes. Thus, concern is more on power awareness of each node so that node remains alive for the longer period of time. The Proposed algorithm is divided into two parts. In first part we consider the weights of nodes using parameters like mobility, degree, and its distance from its neighbors. In second part the available battery power of each node has been considered.

The *battery power* can efficiently be used within certain transmission range, i.e., it takes less power for a node to communicate with other nodes if they are within close distance to each other. However if nodes have maximum battery power to start with, then it would be more accurate metric to measure the power currently available at the node. This in turn depends on the node’s initial power and the power expanded based on the actual network traffic and length of the links used to support it. Battery power of a node depends on two factors i.e. transmission range and type of applications.

Mobility is considered as an important factor. It uses Random waypoint model. It is desirable to elect a node that does not move very quickly. Radio signals transmission is affected by interference, diffraction and shadowing. There should be some limit of speed so that transmission occurs effectively. Less mobility may cause more stable of topology also.

In this paper a new scheme has been suggested which would allow mobile nodes to maintain routes to destinations with more stable route selection. This scheme responds to link breakages and changes in network topology in a timely manner. This makes route maintenance and recovery phase more efficient and fast. Each route table has an entry for number of network nodes attached to it. Whenever need for a new route arises in case of route break, check for network nodes are made, and a new route is established. Route tables are updated at each hello interval as in AODV with added entries for network nodes. Whenever a break in the route phase occurs due to movement of participant node, node damage or for other reasons; these idle nodes which have been termed as network nodes take care of the process and start routing. The whole process becomes fast and more packet delivery is assured. Each route table has an entry for number of network nodes surrounding it and their hop distance from the node.

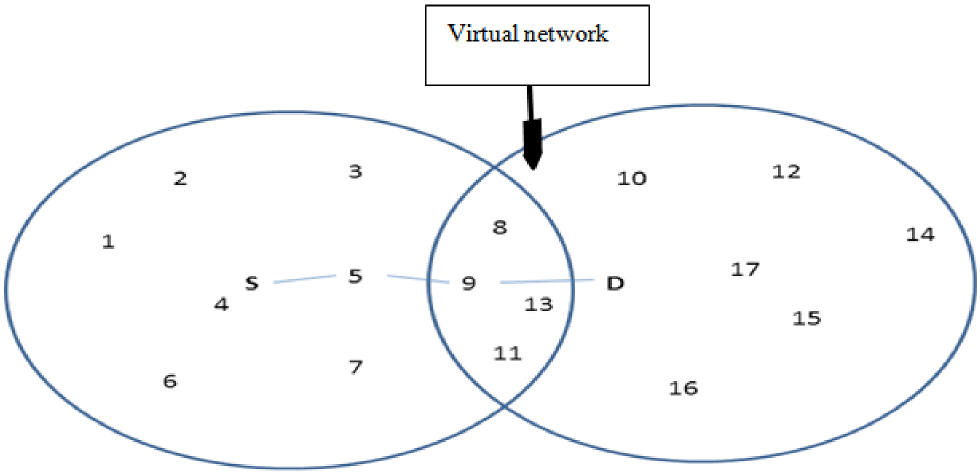


Figure 2: creation of virtual network, It is two hop situation.

Figure 2 represents creation of virtual network . Route established will be **S-5-9-D**. In case of failures of network, self healing nodes will be from virtual network established i.e. nodes 8,11,13. This is case of 2 hop situation. In case of multi hop refer to figure 3.

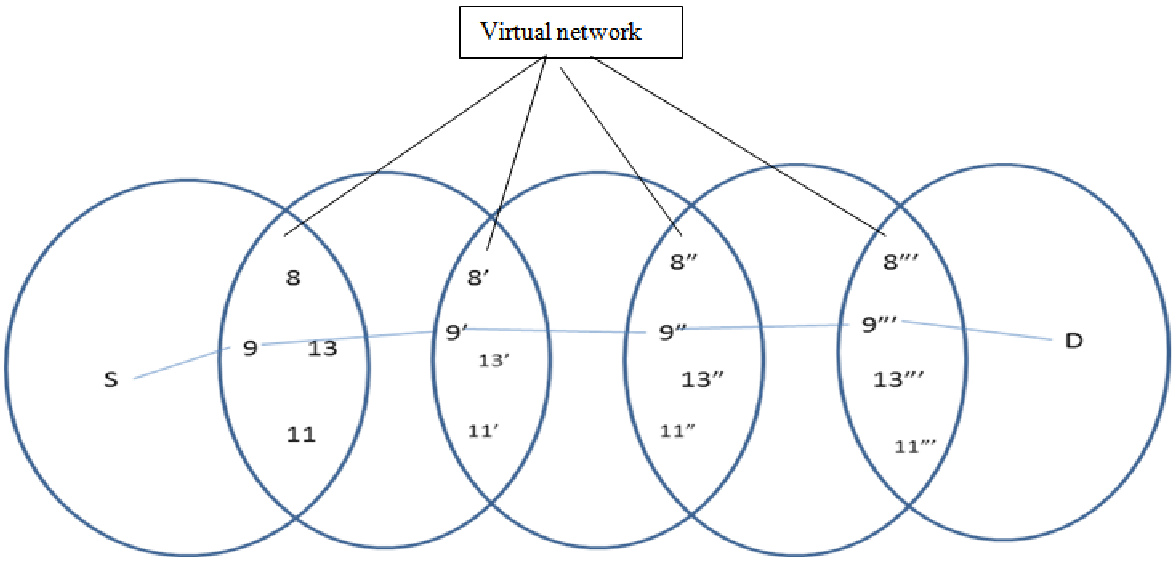


Figure 3: creation of virtual network for multi hop.

Now weight factor is calculated as per algorithm, This factor is updated in each table at each beacon.

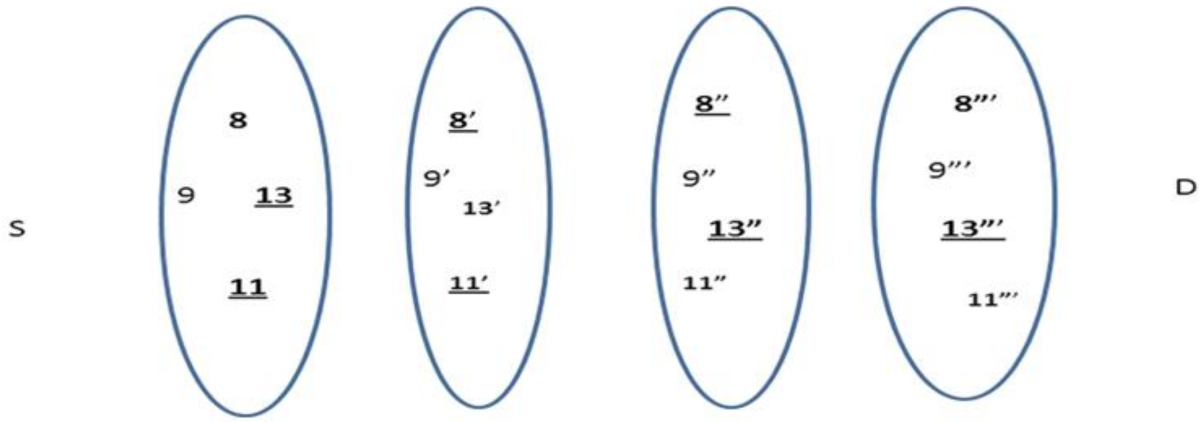


Figure 4: underlines nodes are weighted nodes to participate in case of failures.

In case of failures nodes that are ready to participate are 11,13,8',11',8",13",8"' and 13"'.

Based on these features, an algorithm called *weighted Network algorithm* (*WNA*) is designed. It effectively combines each of the above system parameters.

To select a node in a route, it is to be seen that it can remain for some specified period of time. It is assumed same battery power of all nodes at the initial stage. This assumption helps to consider the battery drainage which gives a direct measure of the available battery power. However, if the nodes have different battery powers to start with, then it would be a more accurate metric to measure the power currently available at the node. This in turn depends on the node's initial power and the power expended based on actual network traffic and length of the links used to support it.

Algorithmic approach is as follows

1. Compute the *probabilistic degree* Δm by (δ / dr) where

$$d_r = |N(r)| = \sum_{r' \in V, r' \neq r} \{dist(r, r') < t_{xrange}\}$$

and δ is a threshold value. If $d_r \leq \delta$, Δm is assumed to be 0.

2. Compute the *probabilistic mobility* $B_m = B_r / B_e$, where B_r is the running average of the speed for every node till current time T.

3. Compute the *probabilistic distance sum* $S_m = (S_r / S_n)$

4. Compute the combined *probabilistic weight* W_m for each node m as the sum of three factors Δm, B_m and S_m.

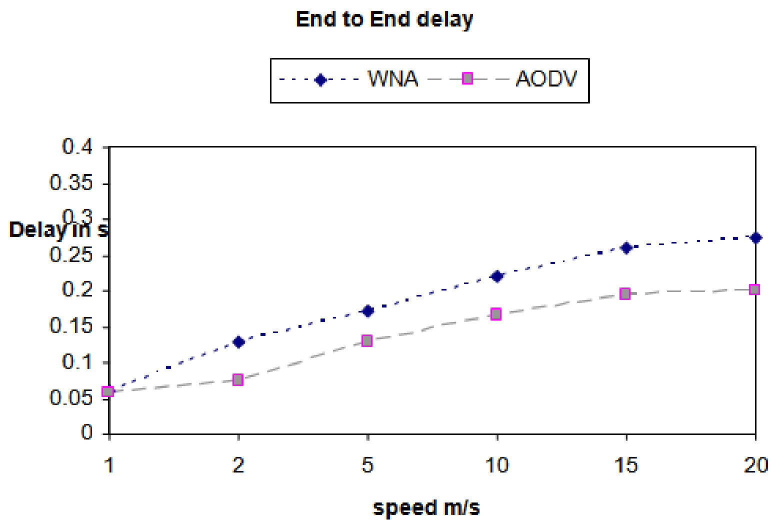
5. Broadcasts its id, W_m and P_{req} by each node at each beacon **.**

The weight factor is added to routing table of each node. This broadcast occurs at each beacon of AODV. The algorithm has been incorporated on AODV.

V. Simulation

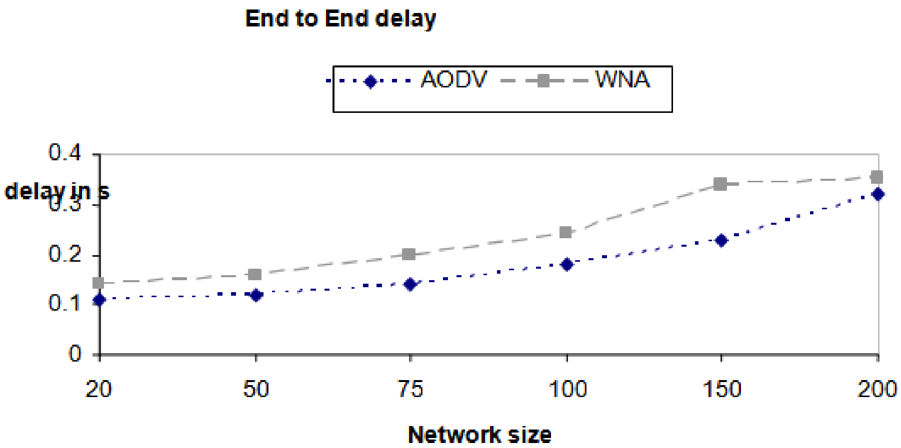
This section deals with the simulation of an environment having nodes on a 1Km ×1 Km area. It is assumed that the nodes can move in all possible directions with displacement varying uniformly between 0 to a maximum value in one unit of time.

In simulation study 75 nodes were taken in a random scenario of size 1 km × 1 km. Two parameters have been taken as Pause time and speed. The study has been conducted at different pause times. Pause time of 0 means maximum mobility and 500 is minimum mobility. The sources connected are 16-20 using TCP connection.

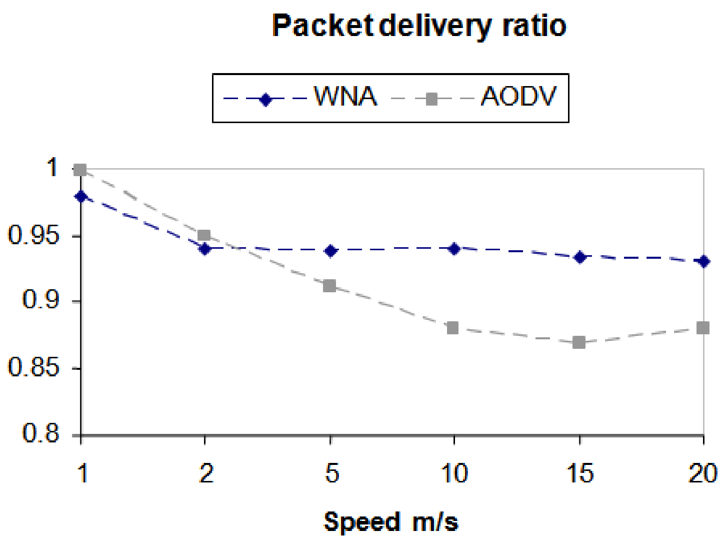


Graph 1: delay for 75 nodes using speed as function

This graph represents delay calculated at various speeds. It is clear that WNA actually has more delay. But the reason is obvious that it requires more calculations. But in the end it provides better routes. Graph 2 has been used to show the effect of delay using various size of network nodes. Number of nodes have been varied and effect has been depicted in Graph-2. Delay is more and it is as per the theory expected.

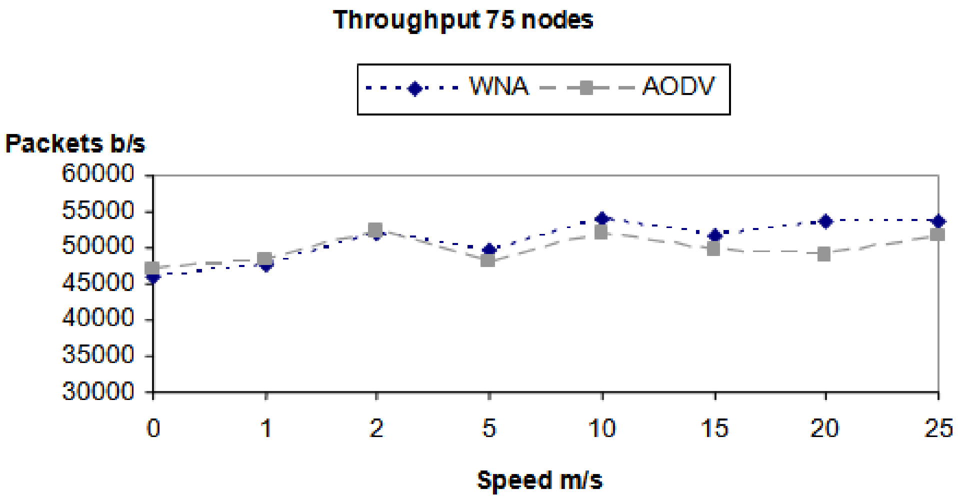


Graph 2: Delay calculated using various network size.



Graph 3: PDR using speed as function

Packet delivery ration denotes that WNA is much better in terms of packet delivery. Moe packets have been delivered. Same is case with Throughput. Graph-4 indicates that WNA has better throughput than AODV at all speeds.



Graph 4: throughput using speed as function

VI. Conclusion

A new scheme has been presented that utilizes weight as a factor for better routing. The scheme can be incorporated into any ad hoc on-demand unicast routing protocol to improve reliable packet delivery in the face of node movements and route breaks. Alternate routes are utilized only when data packets cannot be delivered through the primary route. As a case study, the proposed scheme has been applied to AODV and it was observed that the performance improved. Simulation results indicated that the technique provides robustness to mobility and enhances protocol performance. It was found that overhead in this protocol was slightly higher than others, which is due to the reason that it requires more calculation initially. This also caused a bit more end to end delay. The process of checking the protocol scheme is on for more sparse mediums and real life scenarios and also for other metrics like Path optimality, Link layer overhead.

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