A Selforganized Structure for Mobility Management in Unstable Networks

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***Abstract*:-**The objective of this work is to analyze the unstable mobile nodes with self organization structure in wireless networks. This process enables the nodes to utilize their power fairly, ensures that the links is established between nodes and used to improve the connectivity. In this paper a Self Healing (SH) approach is proposed to improve the connectivity in unstable wireless networks. The proposed work is proved with simulations by analyzing the node degree, coverage area and quality of service (QoS) parameters. The performance of the work is analyzed in network simulator with mathematical models.

Key words: Topology Structure, Computing Analysis, Link Bandwidth and Quality of Service.

Introduction

Topology structure is a technique used mainly in wireless ad hoc networks to reduce the initial topology [1-3] of the network in order to save battery power, reduce interference and extend the lifetime of the network. The main goal is to reduce the number of active nodes and active links, preserving the resources for future maintenance. The necessity of power control [4-5] is given below; it improves the battery life; second, it can impact on the traffic carrying capacity of the network. There are many possible routes to a destination, and the nodes use large transmission power to send packets to relatively remote sensor nodes. Many of these problems can be alleviated by topology control techniques; instead of using the possible connectivity [6] of a network to its maximum possible extent, a deliberate choice is made to restrict the topology of the network. Topology control for ad hoc networks aims to achieve network-wide or session-specific objectives, such as reduced interference, reduced energy consumption, and increased network capacity, while maintaining network connectivity.

A topology control protocol should deal with all network dynamics and ensures that the network is connected with power efficient links. Many topology control algorithms like COMPOW [7] (Common Power), K-neigh [8] and CBTC [9] (Cone Based Topology Control) are used to maintain the power efficiently, but these approaches do not support self organization structures during the movement of the nodes. In K-neigh which assumes continuous transmission until it finds k neighbours, there is no guarantee of connectivity. In the case of CBTC each node keeps on growing the transmitting power until it finds a required neighbor or until the node reaches the maximum power.

2. Proposed Work - Self Healing Approach

2.1 Protocol Description

Let V be the vertices set and E be the set of edges (communication links). Then network graph is denoted as G= (V, E). Each node i϶V has its own position coordinates and identity (id_i).Edges between two nodes i and j is represented as i→j or j→i ϵ E and distance between them is denoted as d (i,j). Initially, every node broadcasts its possible parameters (node degree, link bandwidth etc) to its one hop neighbor. Upon receiving broadcast messages from other nodes, every node keeps track of its neighbours and their strength, storing for each of them the estimated distance. After all the initial messages have been sent, every node in the network knows its neighbor strength. Strength of the neighbor is time varying function and it should be maintained throughout the information exchange process. To achieve this, self healing (SH) nodes are identified between source and destination pairs. Nodes able to form a tree structure is named as SH nodes (used for alternate routing), once a node is identified as a SH node, it allows unidirectional data flow from leaf nodes (node attached with SH nodes or other than SH nodes/source/destination). This unidirectional flow used to improve the network life time and reduce the congestion.

2.2 Self Healing Approach

Self Healing Algorithm

SH node estimation (Stable Phase):

1:Initialize $G_{SH} \leftarrow G$ //load the initial topology

Case I. SH node Selection : (source)

2:For each i ∈ V // i is the source

3:P (i) $\leftarrow$ [L] //initialize the parameter list

4:For each j ∈ SH (i) //find out the SH neighbours of nodei

5:SH(i) $\leftarrow T_{SH}$ (i, j)

// node support Tree (T_{SH}) structure and compute node i and its neighbor SH

Case II. SH to SH neighbor estimation: (Intermediate/Destination)

6:Set $T_{SH}(i) = T_{SH}(j)$ // connect SH neighbors till reach the destination node k.

7:For each $T_{SH} \leftarrow i$ // maintain unidirectional flow

8:$T_{SH} \leftarrow k$ // connect with destination

Case I and II are applicable for stable topology

Mobile Phase: (for connectivity)

9: For each i,j,k ∈ V

10: For each i,j,k $\in T_{SH}$

11:If [i → j] ∈ T_{SH} (i) and [j ≠ i] ∈ V // connectivity between i and j not maintained

11:Remove j from T_{SH} (i)

12:Add [i→*l*] ∈ T_{SH} (i) // *l* be the member of T_{SH}

SH nodes generate a topology with upper bound on the parameter in the order of N. The message overhead needed to build the self healing method is smaller than that needed to build the Minimum Spanning Tree (MST) based graph. Given the some mobility pattern, the SH should be reconfigured much more frequently than the MST graph.

3. Performance Analysis

To evaluate the protocol performance the following metrics are considered.

Number of active links: Each node has links between the other nodes. Due to mobility, some of the nodes act as inactive links. So it is also considered as an important parameter for topology analysis and for the graph between nodes vs. total number of links and the active links.

Throughput: It is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

Average end to end delay: Refers to the time taken for a packet to be transmitted across a network from source to destination. End-to-end delay refers to the time taken for a packet to be transmitted across a network from source to destination. In both static and dynamic the red line indicates the inactive link and black line shows, that a link is still active and maintain the connectivity of the network.

Table 1 Simulation Parameters

Total number of nodes	100
Number of mobile nodes	Localized structure with max. of 20 nodes
Mobility	1 to 4 m/s
Terrain size	1000*1000
Routing protocol	AODV
Propagation model	Two Ray Ground
Path loss exponent	2 or 4
Average Number of communication pairs	10

3.1 Simulation Results

All the simulations are conducted using ns-2 with 100 nodes with a 1000x1000 m^2 deployment area, 0.80s hello interval and random way point model. The parameters used in the simulation are listed in the table 1. Duration of the simulation run is 200 s and pause time interval is 25 seconds for localized computations. Transmitter range for Self Healing nodes and other nodes are 250 and 200m respectively. The transmission power of Self Healing node is 0.3W and other nodes uses 0.2W. During the construction of topology, initially all the nodes are in black color and first level iteration the SH nodes are colored by red and the node movements are represent by the yellow color. The performance of the proposed work is compared with two protocols COMPOW [7] (Common Power) and CBTC [9] (Cone Based Topology Control).

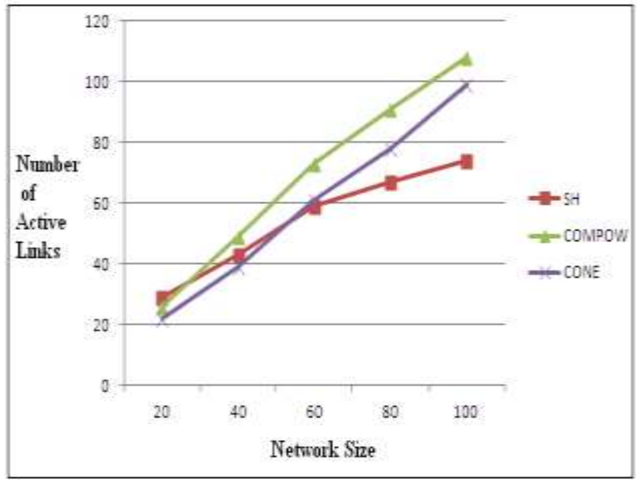

Figure 1 Network size vs active links (Stable Analysis)

The K neigh [8] is not compared with this approach due to more control overhead requirement in the localized domain. In the simulation of topology constructions are analyzed with active links and network size. SH approach reduces the total number of active links. Even if the active links are less, SH maintains the connectivity with efficient links. In Figure 1, it shows that as number of nodes in topology increases, the number of active links increases in SH, because of efficient link selection it reduces number of the active links. The performance of SH and F with various mobile nodes are obtained from simulation analysis and algorithms given in section 2.

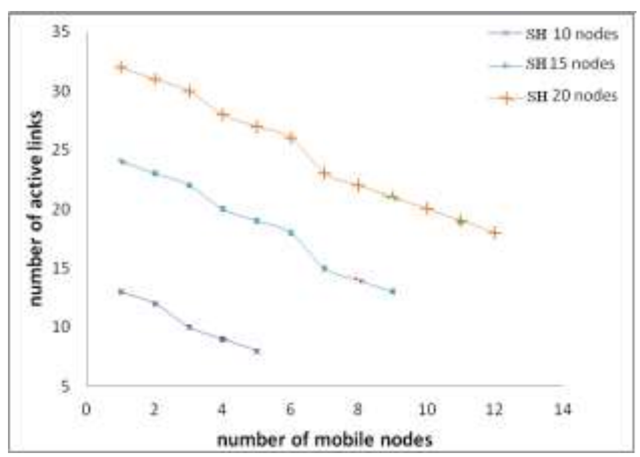

Figure 2 Active links for mobile nodes (Localized structure Analysis)

In SH. when the number of mobile nodes increases the number of active link reduces more than that of neighbors because of the effective selection of links. If nodes are static it provides more connectivity. But if the nodes become mobile the connectivity is reduces. From the Figure 2, localized structure of 20 nodes is analyzed. An optimal connectivity is obtained by moving 11 nodes, but in SH optimal connectivity is obtained before itself. When number of mobile nodes increases the number of loops is reduced.

SH is always selecting the path with node having high power reserve. As the number of nodes in a topology increases the average end to end delay increases as well. In SH the delay is less than that of SH. Because in SH, the number of loops is bigger also it contains more active links. So the selection of the path will take more time than that of other methods. This process is shown in figure 7. From figure 3, shows the delay performance of the proposed work. Delay of CONE is reached a maximum value of 580ms for 100 nodes and SH offers very low delay of 290 ms for the same network size. The other approach produces a delay between 300 to 400 ms. A series of simulation experiments for the Ad Hoc network were conducted using the parameters outlined in the performance metrics.

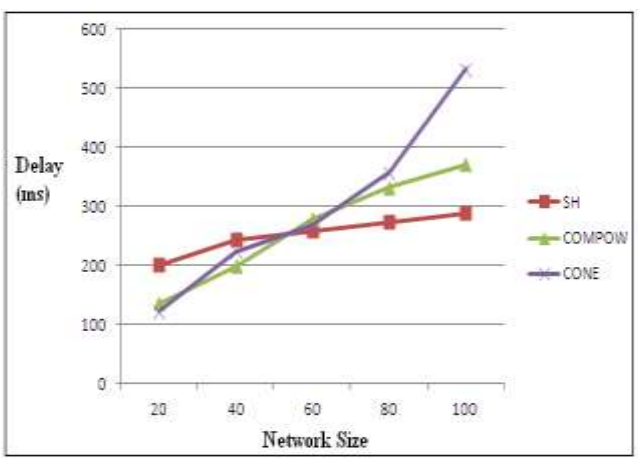

Figure 3 Average end to end delay vs network size

The delay and throughput curves are gives the system performance and capacity. This analysis is shown in Figure 4. From the results proposed approach is comparable with the existing methods. The throughput of the three approaches is comparatively same up to a certain time. After links goes down because of ineligibility in SH the connectivity is lost, but in SH the connectivity is maintaining through efficient paths. The throughput of both approaches is shown in Figure 4. It takes the value between 0.1-1.4 Mbps, SH maintains the constant value due to stable power variation and for the self healing methods throughput reduces for entire simulation time due to selection of one hop neighbor for packet exchange.

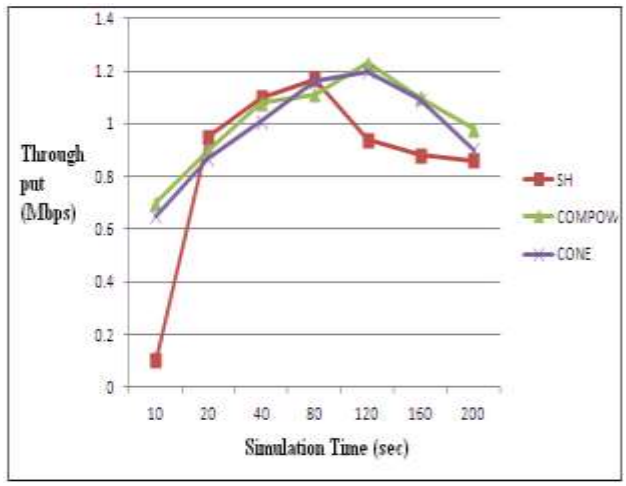

Figure 4 Throughput vs simulation time

4. Conclusion

In this work, minimum power and node degree requirement for each node to transmit information to one hop neighbour is calculated. This process increases the network lifetime and minimize the number of hops required for transmission. Simulation results shows that Self Healing approach requires more number of hops when compared to other methods. Most of the topology control protocols do not consider node mobility into account. This is due to the adaptive nature of the topology, can reduce the connectivity of the network, especially if nodes moving away from each other. This work addresses the connectivity issues in mobile topology environment with self healing and power efficient approaches. This process reduces the management and location tracking process easy in personal communication networks.

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