Power Saving In Ad Hoc Network In Case Of Link Failure

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Abstract

The Ad hoc networks are the wireless networks where the communication takes place through the different nodes. For example, in mobile Ad hoc network, the data is transmitted and received through the different mobile nodes. The work being presented in the paper introduce a technique which has a directional property for route discovery which creates a cluster of only those nodes that are useful for repairing of broken link in link failure. This technique first creates a cluster of nodes which is useful for link repairing, and then it repairs a broken link and repairs a broken route instead of discovering a new route. Because of this method only involves those nodes which are useful for repairing failure link and not involve other nodes of network like ERS scheme, this method saves the power of other nodes of network and increase the lifetime of network. Simulation results obtained are compared with the ERS based AODV protocol. This comparison shows the improvement in the power saving of Ad hoc network

Keywords: *Ad hoc network, Computational capacity, Routing protocols, Static and dynamic routing, Network topology*

1. Introduction

Today, many people carry numerous portable devices, such as laptops, mobile phones, PDAs and mp3 players, in their professional and private lives. For the most part, these devices are used separately that is, their applications do not interact. Imagine, however, if they could interact directly: participants at a meeting could share documents or presentations; business cards would automatically find their way into the address register on a laptop and the number register on a mobile phone; as commuters exit a train, their laptops could remain online; likewise, incoming email could now be diverted to their PDAs; finally, as they enter the office, all communication could automatically be routed through the wireless corporate campus network. These examples of spontaneous, ad hoc wireless communication between devices might be defined as a scheme, often referred to as ad hoc networking. Actually, ad hoc networking as such is not new, but the setting, usage and players are. In the past, the notion of ad hoc networks was often associated with communication on combat fields and at the site of a disaster area; now, as novel technologies such as Bluetooth materialize, the scenario of ad hoc networking is likely to change, as is its importance. The above described features ensure a wide range of applications for ad hoc networks. Some of the application areas are health, military, and home. In military, for example, the rapid deployment, self-organization, and fault tolerance characteristics of ad hoc networks make them a very promising sensing technique for military command, control, communications, computing,intelligence,surveillance, econnaissance and targeting systems. Some other commercial applications include, monitoring product quality, and monitoring disaster areas.

Wireless networks consist of a number of nodes which communicate with each other over a wireless channel. Some wireless networks have a wired backbone with only the last hop being wireless. Examples are cellular voice and data networks and mobile IP. In others, all links are wireless. One example of such networks is multi-hop radio networks or Ad hoc networks.
Another possibly futuristic example, given in [1], may be collections of smart homes where computers, microwave ovens, door locks, water sprinklers, and other information appliances are interconnected by a wireless network.

Wireless Ad hoc networks [2] have known considerable interest recently due to their decentralized feature. A wireless Ad hoc network is a network where a packet of data information from the transmitting handset (known as a node) is sent through different nodes (by multiple hops) to the final destination. This transmission scheme is supposed to increase the flexibility of deploying information infrastructures to cover a given number of users (compared with the case where the information is centralized by a base station).

However, a key issue in data communications with small portable handsets concerns the maximization of battery life (due to energy dissipation in Joules) as well as the efficiency of the network (or data rate in bits/s/Hz). More precisely, considering a given energy at hand for the whole network (total energy of all the handsets), we would like to maximize the number of reliably transmitted bits per joule, rather than the number of bits per second per hertz (spectral efficiency).

2. Key Issues in Ad Hoc Network

2.1 Asymmetric links

Most of the wired networks rely on the symmetric links which are always fixed. But this is not a case with Ad hoc networks as the nodes are mobile and constantly changing their position within network. For example consider a MANET (Mobile Ad hoc Network) where node B sends a signal to node A but this does not tell anything about the quality of the connection in the reverse.

2.2 Routing Overhead

In wireless Ad hoc networks, nodes often change their location within network. So, some stale routes are generated in the routing table which leads to unnecessary routing overhead.

2.3 Interference

This is the major problem with mobile Ad hoc networks as links come and go depending on the transmission characteristics, one transmission might interfere with another one and node might overhear transmissions of other nodes and can corrupt the total transmission.

2.4 Dynamic Topology

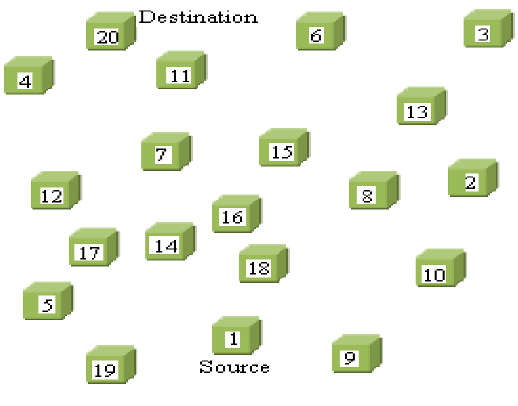
This is also the major problem with Ad hoc routing since the topology is not constant. The mobile node might move or medium characteristics might change. In Ad hoc networks, routing tables must somehow reflect these changes in topology and routing algorithms have to be adapted. For example, in a fixed network routing table updating takes place for every 30sec. This updating frequency might be very low for Ad hoc networks.

2.5 Computational Capacity

The network capacity is a very important parameter to evaluate the performance of Ad hoc network. In fact, the achievable capacity of Ad hoc networks with battery consumption has not yet been determined and can put at stake the Ad hoc network hype. Usual studies of Ad hoc network based on diversity considerations [3] assume that the information going through a node uses only the transmitted power of that specific node (and not the energy related to the process of information). A recent article of Goldsmith et al. [4] based on energy consumption simulations show that this energy cannot be neglected. Mathematically, we can formulate the problem as the multi objective and/or single objective optimization problem. The problem formulation is the maximization of bits (reliably transmitted) per joule and/or maximization of battery life of node and/or maximization of the efficiency of the network subject to the constraints of limited battery life of nodes, transmission power of nodes, and energy related to the process of information (transmitted through nodes). So, this problem can be formulated as the single objective or multi objective optimization problem.

3. Solution

In this paper, we propose an effective and flexible distributed scheme to deploy all the nodes in the Ad hoc network and also to remove failed nodes which are called as failed links. For nodes distribution we have used random topology. The nodes distribution is shown in below figure.



For calculation of shortest path we have used Kruskal's algorithm.

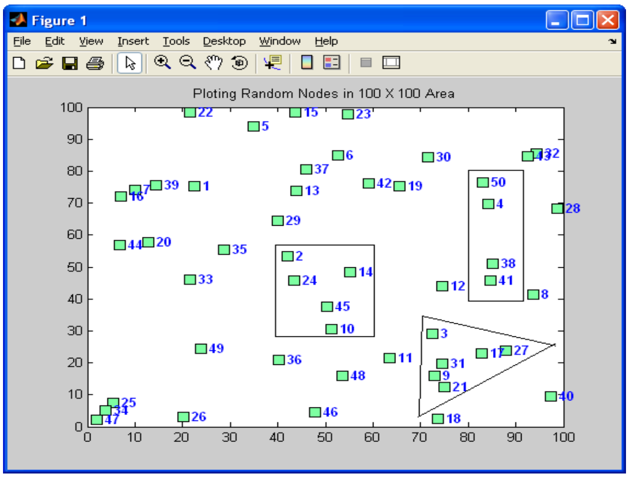
Initially all the nodes are deployed randomly by using the random topology. On the basis of the neighbourhood of the nodes, the nodes are grouped into the clusters which can fit into the different geometrical shapes. These clusters are formed on the basis of the Hausdorff distance. Once the cluster is formed, the shape is selected on the basis of the minimum area requirement.

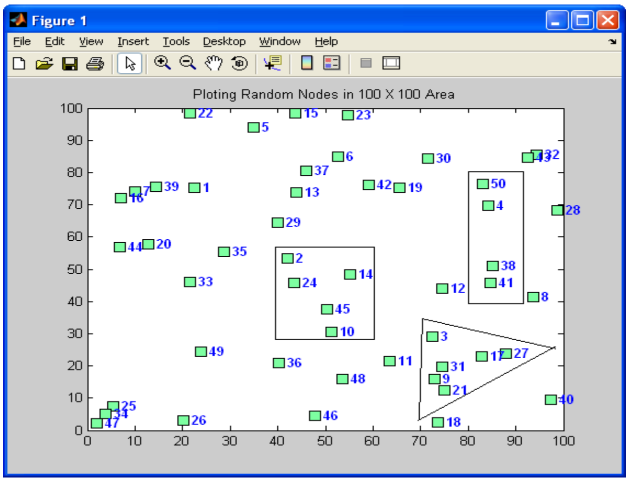
The triangulation and the Voronoi diagrams are used for this decision making in addition with the Hausdorff distance measure. In triangulation, all the nearest nodes are get connected by edge to form the triangles. In Voronoi diagram, individual regions are marked for the each node. From triangulation and Voronoi diagram, the number of triangles and the number of regions concerned with the nodes which are in neighbourhood is calculated. Here, the objective was to have the maximum number of triangles and maximum number of regions which can be inscribed in the relevant geometrical shape with minimum area.

Once the shapes are recorded, the same shapes are used to mark the cluster after mobility of the nodes. To show the results, four simulation runs are carried out with the 50 nodes. Previously recorded shape and new, if any, are used to form the clusters. On the basis of these clusters, the routing algorithm can be designed, where the data transmissions first take place in the shape where the area is less and for this the shortest path may be used. Later, the next higher area shape can be used for data transmission. In this strategic topology, broken nodes in the particular shape do not affect the performance of the routing algorithm as there are many nodes are available for the data transmission.

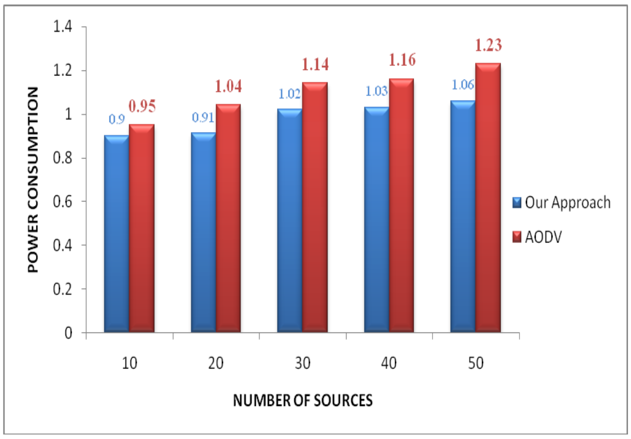
The presented approach is based on the local exploration of the nodes with the limitation of the area of shape. Simulation experiments are carried out on the System Model P4i65GV, Intel HT with 1 GB random access memory in MATLAB 7.1. Experimental results for the simulation run are shown.

The nodes distribution is shown as follows:

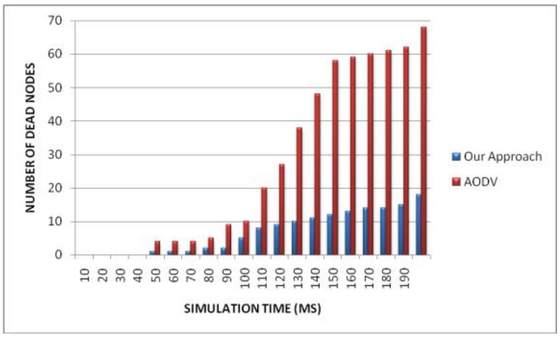




Experimental results of the presented clustering based power saving technique are compared with the AODV protocol with respect to the power consumption and number of dead nodes and shown as follows



Comparison of Power Consumption of Our Approach and AODV



Comparison of Dead Nodes of Our Approach and AODV

4. Conclusion

We have presented a technique for power saving in routing protocol in case of link failure in routing path. Our algorithm first creates a cluster of nodes which is useful for link repairing, and then it repairs a broken link and repairs a broken route instead of discovering a new route. From results it is understandable that the presented approach saves the power consumption in comparison with the AODV routing protocol and it is noticeable that the number of dead nodes through our approach are comparatively too low than the AODV. We have also presented the node deployment strategy which is based on the geometrical shapes. Initially all the nodes are randomly deployed and then our presented strategic node deployment starts. Presented approach uses the Triangulation, Voronoi diagram and Hausdorff distance for the cluster formation and each cluster then marked or covered by the relevant shape of low area.

5. Future work

We did experimentation by using the Hausdorff distance; one can use the Manhattan distance for the cluster formation. We have calculated the shortest path using Kruskal's algorithm, one can use the Bellman ford algorithm to find the shortest path. We have used the defined geometry shapes for the strategic node deployment, one can use the different Polygonal shapes. Strategic node deployment is based on the local exploration of the nodes, one can go for the global exploration, from this point of view Genetic algorithm can be used to optimize the results.

References

[1] "What you will want next and the really smart house", Newsweek, May 30, 1999.

[2] R. Ramanathan and J. Redi, "A brief overview of Ad hoc networks: challenges and directions", IEEE Communications Magazine, vol. 40, May 2002.

[3] M. Grossglauser and D. Tse, "Mobility increases the capacity of ad hoc networks", IEEE/ACM Transactions on Networking, vol. 10, issue 4, pp. 477-486, August 2002.

[4] S. Cui, A. J Goldsmith, and A. Bahai, "Modulation optimization under energy constraints", In proceedings of the IEEE ICC Conference, vol. 4, pp. 2805-2811, 2003.

[5] V. Bharghavan, "A Dynamic Addressing Scheme for Wireless Media Access", IEEE International Conference on Communication, pp. 756- 760, Seattle, WA, 1995.

[6] C. Schurgers, G. Kulkarni and M. B. Srivastava, "Distributed Assignment of Encoded MAC Addresses in Sensor Networks", Proc. of ACM MobiHoc'01, Long Beach, CA, October 2001.

[7] J. Elson and D. Estrin, "Random, Ephemeral Transaction Identifiers in Dynamic Sensor Networks", Proc. of 21st International Conference on Distributed Computing Systems, pp. 459-468, Mesa, AZ, April 2001.

[8] J. Heidemann, F. Silva, C. Intanagonwiwat, R. Govindan, D. Estrin and D. Ganesan, "Building Efficient Wireless Sensor Networks with Low-Level Naming", Proc. of Symposium on Operating Systems Principles, ACM Press, 2001.

[9] M. Ali and Z. A. Uzmi, "An Energy-Efficient Node Address Naming Scheme for Wireless Sensor Networks", IEEE International Networking and Communication Conference INCC`04, 2004.

[10] E. Ould-Ahmed-Vall, D. M. Blough, B. S. Heck and G. F. Riley, "Distributed Global Identification for Sensor Networks", Technical Report 2005, Georgia Tech, 2005.

[11] S. PalChaudhuri, S. Du, A. K. Saha and D. B. Johnson, "TreeCast: A Stateless Addressing and Routing Architecture for Sensor Networks", Proc. of the 18th IPDPS International Workshop on Algorithms for Wireless, Mobile, Ad Hoc and Sensor Networks (WMAN 2004), p. 221a, Santa Fe, New Mexico, April 2004.

[12] Md. Yusuf Sarwar Uddin, Mohammad Ashiqur Rahman and Md. Mostofa Akbar, "Hierarchical Numbering Based Routing Protocol for Wireless Ad hoc Networks", Proc. of 1st International Conference on Next Generation Wireless Systems 2006 (ICNEWS06), Dhaka, pp. 345-349, January 2006.

[13] C. H. Bennett, "Demons, engines and the second law", Scientific American, vol. 257, issue 5, pp. 108-116, November, 1987.

[14] C. H. Bennett and R. Landauer, "The fundamental physical limits of computation", Scientific American, vol. 253, issue 1, pp. 48-56, July 1985.

[15] S. Lloyd, "Computational capacity of the universe", Physical Review Letter, vol. 88, no. 83, 2002.

[16] B. Hajek and G. Sasaki, "Link scheduling in polynomial time", IEEE Transactions on Information Theory, vol. 34, pp. 910-917, 1988.

[17] D. J. Baker, J. E. Wieselthier, and A. Ephremides, "A distributed algorithm for scheduling the activation of links in self-organizing mobile radio networks", In proceedings of IEEE International Conference on Communications, pp. 2F6.1-2F6.5, 1982.

[18] K. Jain, J. Padhye, V. Padmanabhan, and L. Qiu, "Impact of interference on multi-hop wireless network performance", In proceedings of the 9th annual international conference on Mobile computing and networking, pp 66-80, ACM Press, September 2003.

[19] N. Bansal and Z. Liu, "Capacity, delay and mobility in wireless Ad hoc networks", In proceedings of IEEE INFOCOM, April 2003.

[20] U. Kozat and L. Tassiulas, "Throughput Capacity in Random Ad hoc Networks with Infrastructure Support", In proceedings of the 9th Annual International Conference on Mobile computing and networking, ACM Press, September 2003.

[21] M. Grossglauser and D. Tse, "Mobility increases the capacity of Ad hoc wireless networks", In proceedings of IEEE INFOCOM 2001.

[22] P. Gupta and P. R. Kumar, "The capacity of wireless networks", IEEE Transactions on Information Theory, vol. 46, issue 2, pp. 388-404, March 2000.

[23] B. Liu, Z. Liu, D. Towsley, "On the capacity of hybrid wireless networks", In proceedings of IEEE INFOCOM, April 2003.

[24] R. Negi and A. Rajeswaran, "Capacity of power constrained ad hoc networks", In proceedings of IEEE INFOCOM, 2004.