Energy Efficient Route Discovery Algorithm For MANET

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Abstract

An ad hoc network, or MANET (Mobile Ad-hoc Network), is a network collection of nodes, without access point based on self organizing scheme. An important area for research within ad hoc networks is power efficient utilization. Power-optimization is an essential issue for all types of mobile hosts in the network. Nodes in MANET networks are mainly battery control, and thus have method in to a restricted amount of energy. This paper proposes a new method for optimizing energy utilization in MANETs that maximize life time of mobile hosts during packet transmission. It can be achieved by keep away nodes which has a least residual battery power. This method is employed a threshold value on each node and transmitting the fix length of packet on the route. Threshold value used for deciding that any node would be include in routing for packet and fix packet length make equal power use. This method is very effectiveness as traditional methods for power utilization.

1. Introduction

Mobile Ad Hoc Networks (MANETs) is collection of independent nodes that are capable to transmit and received data packet within network. MANET has dynamic topology and free for joining any node and releasing any node from network. It is auto-organized, auto-administrated, auto repaired ability type of network. In MANET, every node work as a router and a terminal as source or destination, thus the breakdown of any node operation can greatly delay the performance of the network and also affect the essential connectivity of the network, i.e., energy consumption of nodes has been one main spoil to the connectivity of MANET. Nodes in MANET have very limited battery power for personal use hence there should use of node power efficiently. MANET is based on cooperation of other nodes to transmit its data within network, so every node works as a router for transmission which is most important issue to manage routing in network. The main problem with this network is continuously changing topology of network as is dynamic behavior for routing packet between source and destination node. There are two type of routing techniques reactive routing and proactive routing for transmitting data reactive routing is mostly used in practical. Due to the arbitrary movement of nodes within the network, routes of nodes may contain multiple hops which makes multicast routing is big task because the multicast tree no remain static, but it's more complex for case of multi-hop communication.

Mobile Ad Hoc Networks (MANETs) stand for the decentralized paradigms where clients themselves sustain the network in the absence of a central infrastructure. MANET does not operate under permanent topology means they are self-organizing, self-administrating, self-healing type of network as shown in fig 1. In MANET, each mobile node operate as both a router and a terminal nodes which is a source or destination, thus the failure of some nodes operation can greatly hinder the performance of the network and also affect the basic accessibility of the network, i.e., energy exhaustion of nodes has been one of the main harm to the connectivity of MANET. Since the mobile nodes in MANET have limited battery power, so it is required to efficiently use energy of every node in MANET In a mobile ad hoc network, all the nodes cooperate with each other to forward the packets in the network, and hence each node is actually a router. Thus one of the most important issues is routing. Since the topology of the network is constantly changing, the issue of routing packets between any pair of nodes becomes a challenging task. Most protocols should be based on reactive routing instead of proactive. Multicast routing is another challenge because the multicast tree is no longer static due to the random movement of nodes within the network. Routes between nodes may potentially contain multiple hops, which is more complex than the single hop communication.

A most important factor of MANETs is energy maintenance due to the restricted lifetime of mobile devices. hence wireless communication could be liable for above half of whole energy utilization [1], so lot of work have done to extend energy-conscious network protocols such as Power-aware routing [2], [3], [4], [5] and transmit power control (TPC)-based algorithms [6], [7], [8], [9]. Basically

they all have deal on efficient energy used for dynamic communication behaviour.

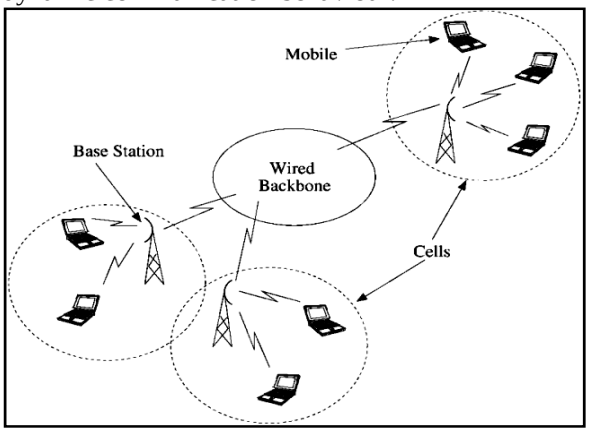

Figure 1. Infrastructure wireless network architecture.

The DSDV [1] establish huge overhead to the network as requirement of the repeated inform messages, and the overhead raises at the measure of O(N2). DSR [2] is that it uses broadcast for route discovery at the same time it broadcast causes too much message forwarding traffic and energy consumption, especially when the network is large. AODV [3] AODV is based on both DSDV and DSR algorithm. It uses the route discovery and route maintenance training of DSR. DSR packet carries the comprehensive route information, while the packet of AODV only carries the destination address, it has a smaller amount of routing overhead than DSR. At the same time, AODV makes use of routing messages and sequence numbering. AODV protocol is a reactive routing protocol which finds route to destination when demanded.

The implementation of DSDV [10] introduces large amounts of overhead to the network due to the requirement of the periodic update messages, and the overhead grows at the quantity of O(N2). DSR [11] utilizes broadcast messages for route discovery at the same time it broadcast reasons moreover many message forwarding traffic and energy use, when the network is bulky. AODV [12] support DSDV and DSR algorithm by implementing goodness of both two algorithm. It utilizes the route discovery and route maintenance training from DSR. DSR packet hold the complete route information, while AODV packet only hold the destination address, it has less routing overhead than DSR. As well as AODV uses of routing messages and sequence numbering too. AODV protocol is an on demand reactive routing type protocol which find route to destination when require.

AODV maintains of routing table which also keep record of route with number with help of this number every route can be identified as it new or old route. The routing table at node stores the sequence number and next hop information. The working of protocol have two part [13] route discovery and route maintenance.

In route discovery, RREQ packets are sent by the source node as sent in DSR algorithm. This RREQ packet passes through node to node, it keep record of reverse path during entire route from destination nodes back to the source node. An intermediate node could either forward the packet or set up a Route Reply (RREP) packet if there is a valid route present to the destination in its cache routing information. To avoid duplicates RREQ packets, SId and BId pair is used. Each intermediary node changed its previous node's address and its Bid, while transmitting a RREQ packet. If an intermediate node has route information for the required destination in its routing table, it compares the destination sequence number in its routing table with that in the RREQ. A max time threshold is also maintained by the node in an attempt to delete a RREQ packet in case the reply has not been received before it expires. Once route is found RREP is generated, it sent back to the source, based on the reverse path that it has set. As the RREP travels back to source, each node along this path sets a forward pointer to the node from where it is receiving the RREP and records the latest destination sequence number to the request destination. Thus the path is established among source and destination node. The Following control packets are used: Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV and these message types are received via UDP [14]. This is called Forward Path Setup. Thus the path is established among source and destination node. In route maintenance process, the source node is being informed by RERR (Route Error) message in case of link break. Also the connectivity between the nodes is upholding using Hello messages. Battery life time and mobility are two main factors that cause link failures.

Many of algorithms are proposed for efficient energy utilization three main approaches are Power-Control, Power-Save and Maximum-Lifetime routing in MANET [15]. Goal of Power-Control method is to increase network capability and dropping energy expenditure by decide the smallest amount of transmission power which is enough to support network connectivity and to pass the traffic with less amount energy. The Power-Save method minimize the energy loss during the node idle state and this helpful for increasing the total time a node use up in the sleep mode. Maximum-Lifetime routing procedure avoided minimum energy node from the path. If any node gets at lowest threshold power level this node is set to sleep mode [16].

2. Related Work

The works done in field of MANET energy conservation are the link stability, energy metrics and the respective routing protocols. Few papers on combined energy-path stability metrics are review [23], [24], [25] and the detailed contributions of this work are listed. Routing strategies and different state info management through routing protocols have been proposed in the literature.

In paper [26] authors described a distributed power control has been deliberate as a method to develop the energy effective of routing algorithms in ad hoc networks. Every node in the network estimates the power required getting its neighbors, and this power estimation is used for modification the transmission power. Paper of [27] authors projected an on-demand protocol based on the MDR metric and using a route discovery mechanism and route maintenance, like Dynamic Source Routing (DSR). Energy efficient Optimization Link State Routing was proposed in [28] it based on the proactive info management and on the selection of Multipoint Relay (MPR) uses of power metrics, such as MMBCR and MDR. Life-time Prediction-based Routing (LPR), to minimization variances of the nodes residual energies in the network proposed in [29]. this protocol, predict the future energy expenditure for each node, however its evaluation depends on various issue such as node distances, remaining battery power, hop count, and node movement.

A number of routing algorithms make use of the connection lifetime as well as the nodes' battery power as routing constraint to permit the most trustworthy and energy proficient route to be preferred for data transmission. Alternate Link Maximum Energy Level Ad Hoc Distance Vector Scheme for Energy Efficient Ad Hoc Networks Routing [17] has improved the usual routing protocol by take advantage of higher energy path and backup route. An Energy-Efficient On-Demand Routing Algorithm for Mobile Ad-Hoc Networks [18], an energy efficient metric for MANETs to reduce energy spending and enhance the network's permanence, authors mainly focused on increasing the network life by distribute energy use in the network. LSEA: Link Stability and Energy Aware for Efficient Routing in Mobile Ad Hoc Network [19] explain a new routing protocol a modified version of Ad-hoc On Demand Distance Vector (AODV) protocol using random waypoint to model node mobility.

Energy saving potential of cyclic sleep in optical access systems [20] initiated load adaptive techniques where network elements/subsystems are powered off during periods of reduced network load. The finite wake-up time of systems and components reduces the energy savings of cyclic low power modes. Energy Efficient Integrated Routing Protocol for MANETs [21] has an Energy Efficient Integrated Routing Protocol (E2IRP) for Mobile Ad Hoc networks used in remote surveillance systems. The event information is routed towards the gateway from one tier to another and the reply is routed back to the source, in the same manner. Performance of Ad hoc Network Routing Protocols in IEEE 802.11 [22] author's approach must take into account the ad-hoc networks specific characteristics: dynamic topologies, limited bandwidth, energy constraints, and limited physical security.

3. Related Proposed Method

This section presented a new algorithm which takes the network lifetime and optimal power consumption in to account intended for transmission. The proposed approach was implemented in the dynamic stipulation architecture. Assume that the architecture composed by core and access routers as shown in fig 2.

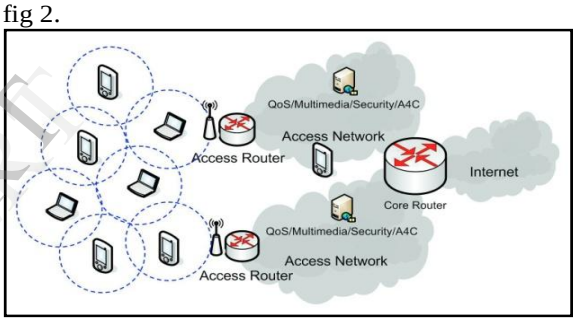

Figure 2. Distributed architecture

Topology monitors are installed on each access and core routers to determine transmission power of each mobile host. Consecutively it helps to discover best host in the network for transmission which is referred as topology control is addressed in [30] the proposed algorithm for power saving is deployed in all path. Each access router collects the measurements performed by topology monitors and opts alternate with all other access routers to report the current topology information. In addition it takes into account the congestion information reported by core routers to allocate an alternate route dynamically and efficiently,

According to the above discussion the following points are derived to design an algorithm

3.1. No Routing Delay

All the above protocols are intended to decide the minimum power consumption route in advance. Owing to the mobility in the MANET, the route discovery in our algorithm is in dynamic by taking into consideration of threshold value in each mode. Choose the mode which has less power but not less than the threshold value. To decrease the

interferences our algorithm desire to select the less power node for transmission.

3.2. Optimal power consumption:

Our algorithm transmits the message as an equal length of packets in favor of equal power consumption by all the nodes in the route. Periodical invigilation is carried out to make sure the residual energy of each node is not away from the required level. If the node goes beyond the threshold value revolutionized it into sleep node and selects an alternate node for transmission.

The key point in the above discussion is to minimize power consumption and minimize lifetime of the entire network the proposed algorithm is as follow:

1. At the source mode divide the message into equal length of packets and select a mode I where min(Ei>Thi) from all the neighboring node.
2. Establish a route to destination wherein the energy level of all the nodes is greater than its threshold value.
3. Repeat the following steps in periodical interval t.
4. Calculate the residual energy of each mode in them route with the equation
5. Eres=E-Ec(t)
6. Where E the initial energy of a mode Ec(t) energy consumed in periodical interval t and Eres residual energy of a mode.
7. Energy consumption of a mode after time t is calculated using the following equation.

$$Ec(t)=Nt*a+Nr*b$$

where Ec(t) energy consumed by a node after time t Nt number of packets transmitted by the node after time t and Nr number of packets received by the node after time t. a and b are constant factor having a value between 0 and 1.

If Eres>Threshold value continue the transmission through the same node.

Else dynamically find an alternate route for further transmission which satisfies constrain outlined in our approach.

4. Conclusion

One of the most important research areas within wireless communication is wireless services continue to add more capabilities such as multimedia and QoS, low-power design remains. These researches have to center on reduce the total energy spent by the wireless nodes. Power management has usually been considered at physical layer. But, most of the energy savings at the physical layer have already been accomplish. as a result, the solution to energy conservation in wireless communications can be achieved within the higher layers of the wireless protocol model. This paper presents the power management in MANET with attributes like random mobility and multi-hop communication is discussed in detail. It is found that the two important issues the power dynamic route discovery forces the mode into sleep mode to retain the minimum energy route establishment prospect. Still power preservation within the wireless network remains a extremely critical research area for the practicality of wireless services in the upcoming time.

5. References

[1] R. Kravets and P. Krishnan, "Power Management Techniques for Mobile Communication," *Proc. ACM MobiCom*, pp. 157-168, 1998.

[2] J.-H. Chang and L. Tassiulas, "Energy Conserving Routing in Wireless Ad-Hoc Networks," *Proc. IEEE INFOCOM*, pp. 22-31, 2000.

[3] S. Singh, M. Woo, and C.S. Raghavendra, "Power-Aware Routing in Mobile Ad Hoc Networks," *Proc. ACM MobiCom*, pp. 181-190, Oct. 1998.

[4] K. Woo, C. Yu, H.Y. Youn, and B. Lee, "Non-Blocking, Localized Routing Algorithm for Balanced Energy Consumption in Mobile Ad Hoc Network," *Proc. Ninth Int'l Symp. Modeling, Analysis and Simulation of Computer and Telecomm*. Systems (MASCOTS '01), pp. 117-124, 2001.

[5] J. Wu, M. Gao, and I. Stojmenovic, "On Calculating Power-Aware Connected Dominating Sets for Efficient Routing in Ad Hoc Wireless Network," *Proc. Int'l Conf. Parallel Processing (ICPP '01),* pp. 346-356, 2001.

[6] S. Agarwal, S.V. Krishnamurthy, R.H. Katz, and S.K. Dao, "Distributed Power Control in Ad-Hoc Wireless Networks," *Proc. IEEE Int'l Symp. Personal, Indoor and Mobile Radio Comm. (PIMRC '01*), pp. 59-66, 2001.

[7] J. Gomez, A.T. Campbell, N. Naghshineh, and C. Bisdikian, "Conserving Transmission Power in Wireless Ad Hoc Networks," *Proc. Ninth IEEE Int'l Conf. Network Protocols (ICNP '01),* pp. 24-34, 2001.

[8] E.-S. Jung and N.H. Vaidya, "A Power Control MAC Protocol for Ad Hoc Networks," *Proc. ACM MobiCom*, pp. 36-47, 2002.

[9] V. Kawadia and P. Kumar, "Power Control and Clustering in Ad Hoc Networks," *Proc. IEEE INFOCOM*, pp. 459-469, 2003.

[10] C. Perkins and P. Bhagwat, "Highly dynamic destination-sequenced distance-vector routing (DSDV) for mobile computers," in *ACM SIGCOMM'94 Conference on Communications Architectures, Protocols and Applications*, 1994, pp. 234-244, 1994.

[11] D.B. Johnson and D.A. Maltz, "Dynamic source routing in ad hoc wireless networks," in *Mobile Computing, Imielinski and Korth, Eds. Kluwer Academic Publishers*, vol. 353. pp. 153-181, 1996.

[12] C. Perkins, E. Belding-Royer and S. Das, "Ad hoc On-Demand Distance Vector (AODV) Routing," *RFC* 3561 (Experimental), Jul. 2003.

[13] Tripti nema, Akhilesh waoo, PS. Patheja, Sanjay Sharma, "Energy based AODV Routing Algorithm with Sleep Mode in MANETs" *International Journal of Computer Applications (0975-8887)* vol.58, No.19, November 2012.

[14] Roopal Lakhwani, Sakshi Suhane Anand Motwani, "Agent based AODV Protocol to Detect and Remove Black Hole Attacks*" International Journal of Computer Applications (0975-8887)* vol.59, No.8, pp. 35-39, December 2012.
[15] J. Li, D. Cordes, and J. Zhang, "Power-aware routing protocols in ad hoc wireless networks," *IEEE Trans. Wireless Commun.*, pp. 69-81, Dec. 2005.
[16] Tripti nema, Akhilesh waoo, PS. Patheja, Sanjay Sharma, "Energy Efficient Adaptive Routing Algorithm in MANET with Sleep Mode", *International Journal of Advanced Computer Research*, vol.2, Issue 6, pp.431, 2012.
[17] Tai Hieng Tie, Chong Eng Tan, Sei Ping Lau "Alternate Link Maximum Energy Level Ad Hoc Distance Vector Scheme for Energy Efficient Ad Hoc Networks Routing" *International Conference on Computer and Communication Engineering (ICCCE 2010)*, pp.1-6, 11-13 May 2010.
[18] Sanjay Kumar Dhurandher, Sudip Misra, Mohammad S. Obaidat, Vikrant Bansal, Prithvi Singh, Vikas Punia "An Energy-Efficient On-Demand Routing Algorithm for Mobile Ad-Hoc Networks", *International Conference on Computer and Communication Engineering*, pp. 995-961, Aug. 31 2008-Sept. 3 2008.
[19] Sofian Hamad, Hadi Noureddine and Hamed Al-Raweshidy, "LSEA: Link Stability and Energy Aware for Efficient Routing in Mobile Ad Hoc Network", *Wireless Personal Multimedia Communications (WPMC),* 14th International Symposium on 2011, pp. 1-5, Oct. 2011.
[20] Björn Skubic, Alexander Lindström, Einar In de Betou, and Ioanna Pappa" Energy saving potential of cyclic sleep in optical access systems"*2011 IEEE online conference on Green communication*, pp. 124-127, March 30, 2011.
[21] Dr. K. Kathiravan , V. Divya , Dr. S. Thamarai Selvi ,"Energy Efficient Integrated Routing Protocol for MANETs", *Fifth International Conference on Mobile Ad-hoc and Sensor Networks*, pp.340-346, 2009.
[22] Dr Chandra Shekar Reddy Putta , Dr K.Bhanu Prasad , Dilli Ravilla, Murali Nath R.S, M.L.Ravi Chandra "Performance of Ad hoc Network Routing Protocols in IEEE 802.11" *ICCCT*, pp. 371-376, Sep. 2010.
[23] K.-J. Kim and S.-J. Yoo, "Power-Efficient Reliable Routing Protocol for Mobile Ad-Hoc Networks," *IEICE Trans. Comm.*, vol. E88-B, pp. 4588-4597, 2005.
[24] F. Guerriero et al., "A Biobjective Optimization Model for Routing in Mobile Ad Hoc Networks," *Applied Math. Modeling*, vol. 33, pp. 1493-1512, Mar. 2008.
[25] F. De Rango et al., "A Multi-Objective Approach for Energy Consumption and Link Stability Issues in Ad Hoc Networks," *IEEE Comm. Letters*, vol. 10, no. 1, pp. 28-30. Jan. 2006.
[26] P. Bergamo, D. Maniezzo, A. Travasoni, A. Giovanardi, G. Mazzini, and M. Zorzi, "Distributed Power Control for Energy Efficient Routing in Ad Hoc Networks," *Wireless Networks* J., vol. 10, no. 1, pp. 29-42, 2004.
[27] K. Dongkyun;, J.J. Garcia-Luna-Aceves, K. Obraczka, J.-C. Cano, and P. Manzoni, "Routing Mechanisms for Mobile Ad Hoc Networks Based on the Energy Drain Rate," *IEEE Trans. Mobile Computing*, vol. 2, no. 2, pp. 161-173, Apr.-June 2003.
[28] F. De Rango, M. Fotino, and S. Marano, "EE-OLSR: Energy Efficient OLSR Routing Protocol for Mobile Ad-Hoc Networks," *Proc. IEEE Military Comm. Conf. (Milcom '08)*, pp. 1-7, Nov. 2008.
[29] N. Meghanathan, "Stability-Energy Consumption Tradeoff among Mobile Ad Hoc Network Routing Protocols," *Proc. Third Int'l Conf. Wireless and Mobile Comm. (ICWMC '07),* Mar. 2007.
[30] Nikolaos A. Pantazis, and Dimitrios D. Vergados, A Survey On Power Control Issues In Wireless Sensor Networks", *IEEE Communications Surveys & Tutorials*, VOLUME 9, NO.4, 2007, pp.86-107.