Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia Engineering 38 (2012) 903 – 910

Procedia Engineering

www.elsevier.com/locate/procedia

Conference Title

AN OPTIMIZED ENERGY CONSUMPTION ALGORITHM FOR MANET

Ms.S.Suganya[a], Dr.S.Palaniammal[b]

[a] Sr.Lecturer, Dept. of Computer Applications, TamilNadu College of Engineering, Coimbatore, India
[b] Prof.& Head, Dept. of Science and Humanities, Sri Krishna College of Technology, Coimbatore, India

Abstract

Power-optimization is an essential issue for all types of mobile hosts in the network. This paper proposes a new approach for optimizing power consumption in mobile ad hoc networks (MANETs) that consents to maximum life time of mobile hosts while transmitting a packet from the source to destination. It can be implemented by avoiding nodes which has a minimum residual battery power. The proposed approach is implemented by introducing a threshold value on each node and transmitting the equal length of packet on the route. This threshold indicates whether the node should be included in making routing decisions for a packet and length of the packet considered for equal power consumption. Extensive simulation results are presented to verify the effectiveness of the proposed approach.

Keywords: Maximum network lifetime; Threshold value; Power consumption, Length of Packet;

1. Introduction

A Network is a collection of interconnected nodes. It can be wired, wireless or wired cum wireless. Among the various network architectures, the design of mobile ad hoc network (MANET) is paid lot of attention in recent days. A MANET is a set of mobile hosts which can communicate with one another and

doi:10.1016/j.proeng.2012.06.113

roam around at their determination [1]. Fig.1 shows a general structure of MANET. No base stations are supported in such an environment, and mobile hosts may have to communicate with each other in a multi-hop fashion.

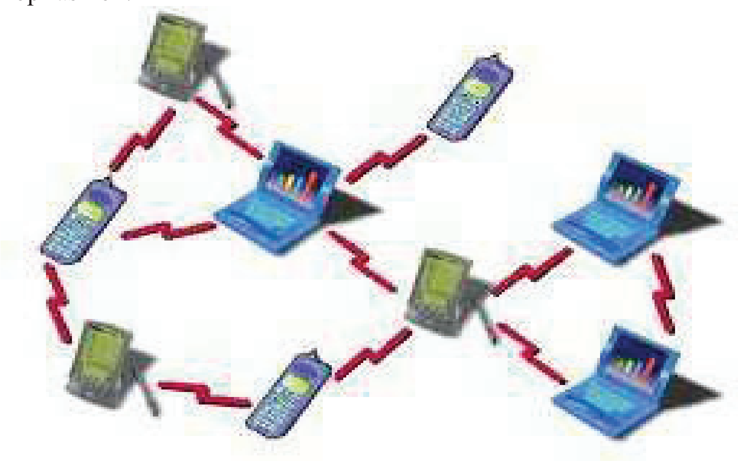

Fig.1 Mobile Ad hoc Network

Since MANETs are infrastructure-less, self-organizing, rapidly deployable wireless networks, they are appropriate for applications like, communications in areas where no wireless infrastructure, emergencies and natural disasters, and military operations [2, 3]. MANETs are anticipated to support a variety of services with various quality-of-service (QoS) requirements. For example, a fusion of delay-sensitive applications (e.g., voice and video teleconferencing) and delay-tolerant applications (e.g., web browsing and file downloading) must be supported [4]. Since, the two principal MANET resources bandwidth and energy are inadequate, the main challenge while designing such a network is to use those resources as efficiently as possible for providing the QoS requirement of users. The nodes in this type of networks are generally power constrained because they depend on limited battery resources, whereas wireless communications consume a lot of energy. Without the resource, power, mobile devices will become useless. So, maximizing the lifetime of batteries of each host and entire network is an important issue, especially for MANET, which is supported by batteries only. Solutions addressing the power-saving issue in MANETs can generally be categorized as Techniques to minimize active communication energy and Techniques to minimize inactive Energy.

The active communication energy techniques named as Transmission Power Control, Load distribution and power management are addressed in [5]. This paper centers the power management approach by introducing threshold value for each node and forces it into sleep mode when it has less energy, thus falls into the category of minimize active communication energy. The considered MANET is characterized by multi-hop communication, unpredictable mobility and no equal length of packet for transmission. The two major challenges encountered while designing a new approach for optimized power consumption are, neighbor discovery and widespread power consumption. This paper proposes a new service model that to resolve the above problems by maintaining residual energy of each host to easy discover of neighbor. In addition, the transmission will takes place with equal length of packets for extensive power consumption. This approach is implemented in scattered provisioning architecture intended with core and access routers. The core routers are responsible for monitoring the topology and if importunate congestion is detected, it immediately reports to access routers. Based on communication from core routers, access routers determine the alternate route dynamically and efficiently using the proposed algorithm. Moreover, the access routers are periodically monitoring power consumption of each node and force the node into sleep mode if necessary.

The rest of this paper is organized as follows. Related work has discussed in Section 2. In Section 3, the proposed power-saving algorithm is presented. Simulation results are discussed in Section 4. Section 5 concludes this paper.

2. Related Work

In MANET while creating correct and efficient routes between pair of nodes, one important objective of a routing protocol is to maximize the lifetime of network. As discussed in the introduction, this objective can be proficient by optimizing the energy of mobile nodes not only when they are inactive but also when they are in active communication. Transmission power control , load distribution and power management are the approaches to minimize the active communication energy, and sleep/power-down mode is used to minimize energy during inactivity [6]. In this section we discussed some existing approaches for optimizing power consumption as well as to maximize the network lifetime.

In [7] authors, suggested an approach to minimize power consumption in idle mode of mobile nodes. They proposed an idea to change mode of the mobile nodes from Idle to Sleep, i.e nodes neither transmit nor receive data packets., but in Idle mode the node can consume power as consume in receiving mode. They take two ad hoc on-demands routing protocols and implemented this approach and concluded that power consumed by these protocols, with this mechanism is less than power consumed without this.

In [8], authors Canan Aydogdu and Ezhan Karasan proposed an analytical model for the IEEE 802.11 DCF in multi-hop wireless networks that considers hidden terminals and accurately works for a large range of traffic load that are used to analyze the energy consumption of various relaying strategies. They gave fact of the existing analytical models of IEEE 802.11 DCF systems were inadequate for an energy efficiency analysis in wireless multi-hop networks. They concluded that this analytical model is accurate in predicting the energy-efficiency over a wide range of scenarios. The given results show that the energy efficient routing strategy depends not only on the processing power but also depends on the traffic load.

Author Seung Hwan Lee, in [9], projected an energy efficient power Control mechanism for base station in mobile communication systems and an efficient sector power control based on distance between base station and mobile node. They also proposed a sleep mode energy control mechanism. In sleep mode energy saving protocol, each sector monitors the number of user in sector cell. They proposed, if number of mobile node falls down a given threshold in sector cell, base station shuts down power. They also proposed an algorithm and demonstrated the tradeoff between energy saving and cell coverage in order to enhance efficient use of base station Transmission power.

The PAMAS (Power Aware Multi-Access protocol with Signaling) [10] protocol consent to a host to sleep mode when it has no packet to transmit/receive or any of its neighbors is receiving packets, but it required a separate signaling channel to inquiry the status of neighboring hosts. Hence this protocol provides best results in dense networks but the power saving is low in small network. MTPR (Minimum Total Transmission Power Routing)[11] is an approach to minimize total transmission power consumption by all nodes. MTPR calculates the total transmission power for all routes between source and destination. Among all routes it will select the route with minimum total transmission power. The total transmission power of route is calculated using the formula

$$P(R) = \sum_{i=0}^{D-1} T(n_i, n_i + 1)$$

Where i refer the number of nodes appears in the route from source to destination. But this decision increases the end-end delay in the transmission. This approach also increases the number of hops in the route. The lifetime of the network also not considered in this approach because the selected routes are via specific host, the battery of this host will be exhausted quickly. MMBCR [11](Min-Max Battery Cost Routing) is an approach by selecting nodes with more residual-battery capacities in a route. With the intention that in this approach the battery of each host will be used more fairly than in previous scheme.

But it can consume more power to transmit user traffic and there is no guarantee that minimum total transmission path will be selected always. This approach is not paying attention to maximize the lifetime of all nodes.

3. Min power consumption & Max lifetime algorithm

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 stipulating architecture. Assume that the architecture composed by core and access routers, as shown in Fig.2.

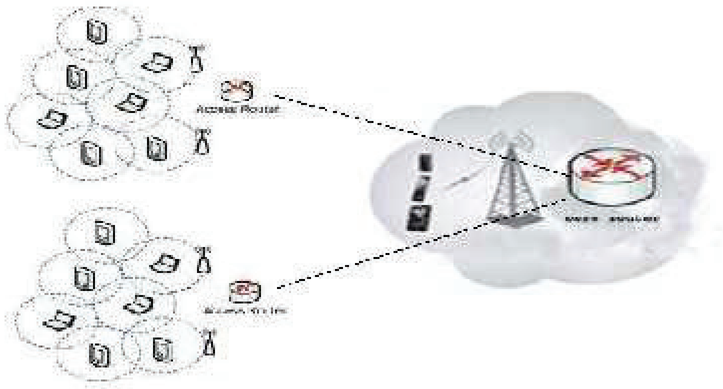

Fig.2 Distributed Architecture

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 [3]. The proposed algorithm for power saving is deployed in all access routers. The threshold value for each node is calculated as $\min\{0.15E_i\}$ $\forall$ nodes in the transmission path. Each access router collects the measurements performed by topology monitors and opts alternate route, if the residual energy of the node is less than the threshold value and exchange update messages 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:

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 node. Choose the node which has less power, but not less than the threshold value. To decrease the interferences, our algorithm desires to select the less power node for transmission.

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 mode and selects an alternate node for transmission.

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

1. At the source node , Divide the message into equal length of packets and select a node i where min($E_i > Th_i$) 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 node in the route with the equation

   $$E_{Res} = E - E_{c(t)}$$

   Where E, the initial energy of a node, $E_{c(t)}$, energy consumed in periodical interval t and E_{Res}, Residual energy of a node.
5. Energy consumption of a node 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 factors having a value between 0 and 1.
6. If $E_{Res} >$ Threshold value Continue the transmission through the same node
7. Else dynamically find an alternate route for further transmission which satisfies the constraint outlined in our approach.

4. Simulation Results

This section provides the simulation results and shows the effectiveness of the proposed algorithm compared to the existing algorithms like, MTPR and MMBCR. The proposed scheme is simulated using network simulator NS-2. Network scenarios have been setup for 20, 40, 60, 80 and 100 nodes in an area of 1000 * 1000 m. In the different scenarios, value for packet delivery ratio has been observed by varying pause times from 0 to 100 seconds. Fig.3 depicts the simulation scenario for implementing proposed algorithm with 60 numbers of nodes. Experiment has been performed for different set of mobile nodes with different speed to check Power Consumption, Packet Drop and End to End Latency.

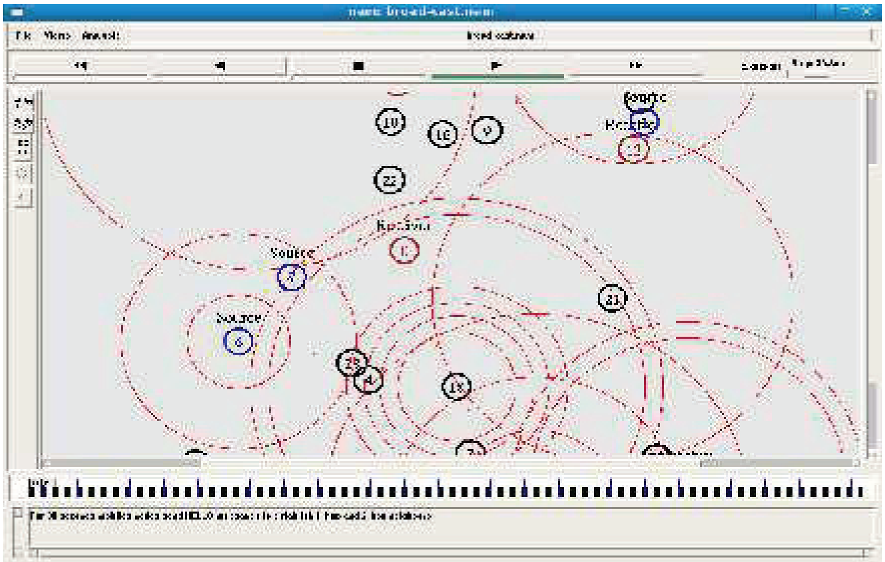

Fig.3 Simulation Scenario

Simulation scenarios and parameters are given in Table 1. Values for transmit, receive and idle power have been used directly as mentioned in energy model of [12].

Table1. Parameter values for Simulation Scenario

Parameter	Value
Transmit Power	1.3 W
Receive Power	966.96 mW
Idle Power	843 mW
MAC Protocol	802.11
Routing protocol	DSR
Network Scenario (s)	For 20 ,40,60,80 and 100 Nodes

Equal lengths of packets are sent from source to destination with simulation time of 100Sec. and power consumption is calculated for different number of nodes like, 20,40,60,80,100. It is clear from Fig. 4.(a) that initially the proposed approach MPML and MTPR slightly differs. But when the number of nodes increased, the power consumption is high. This is because the selected routes are via specific host, the battery of this host will be exhausted quickly in MTPR and at the same time the total power consumption is high. But in the case of MMBCR initially it consumes more power to transmit user traffic, however in conclusion the battery of each host will be used more fairly than in previous scheme. It is observed from the graph that energy consumption optimizes in the case of proposed scheme when the number of nodes increases.

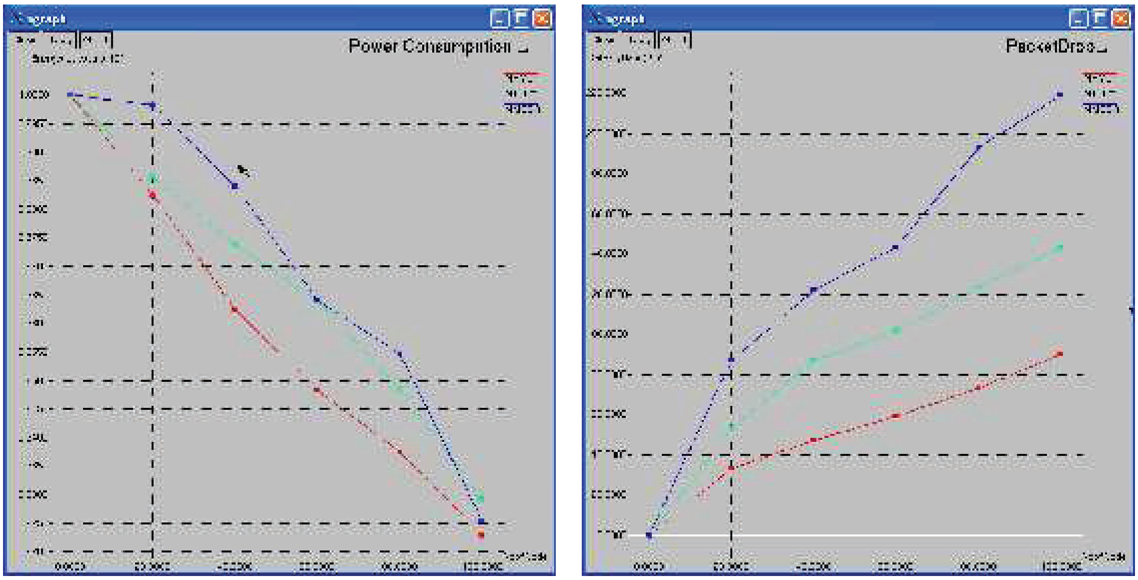

Fig.4 (a)Power Consumption;(b) Packet Drop

The Fig. 4.(b) shows the proposed algorithm is optimized in the packet delivery because of the reason that the proposed algorithm centered on dynamic discovery of route when any congestion occurs or energy level of host becomes lower than thershold value. In the Fig.5 clearly depicts that the initial decision making on the subject of the route cause more end to end delay on the transmission. Hence this proposed approach reduces the end to end delay even if the number of nodes increases.

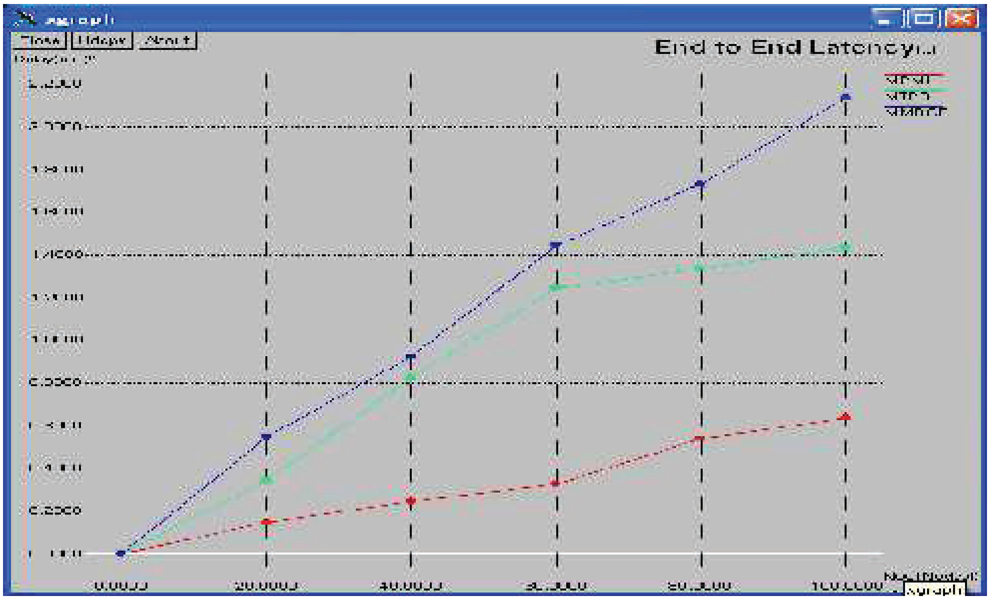

Fig.5 End to End Latency

5. Conclusion

In this paper the power management in MANET with characteristics like, unpredictable mobility and multi-hop communication is discussed in detail. It is found that the two important issues, the power optimization and Maximize network lifetime can be resolved by introducing a threshold value. The dynamic route discovery forces the node into sleep mode to retain the minimum energy level. Simulation results have shown that proposed approach can save lot of energy with realistic route establishment prospect.

References

[1].C.E.Perkins, “Ad Hoc Networking”, AddisonWesley, 2001.
[2].S.Misra,I.Woungang and S. C. Misra, “Guide to Wireless Ad Hoc Networks”, Springer science, 2009.
[3]. 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
[4]. Jaydeep Punde, Nikki Pissinou, and Kia Makki, “On Quality of Service Routing in Adhoc Networks, ” Proc. 28th Annual IEEE Conference on Local Area Network (LCN’03), IEEE Comp. Society, pp 276-278, 20-24 Oct, 2003.
[5].Ashwani Kush, Sunil Taneja and Divya Sharma, “Energy Efficient Routing for MANET”, IEEE, 978-1-4244-9703- 4/101, 2010.

[6].Mrs. Suganya Senthil, Dr.Palaniammal Senniappan, "A Detailed Study on Energy Efficient Techniques for Mobile Adhoc Networks", International Journal of Computer Science Issues, Vol. 8, Issue 5, No 1, September 2011
[7] P.K.Sahoo, J.P.Sheu and K.Y.Hsieh, "Power control based Topology construction for the distributed wireless sensor Networks", Science Direct, Computer Communications, vol. 30, pp. 2774-2785, June 2007.
[8]. Canan Aydogdu and Ezhan Karasan, "An Analysis of IEEE 802.11 DCF and Its Application to Energy-Efficient Relaying in Multi-Hop Wireless Networks", IEEE Trans. on mobile computing, 2010.
[9] Seung Hwan Lee , Yonghoon Choi, Suwon Park and Seung Hyong Rhee, "An Energy Efficient Power Control Mechanism for Base Stations in Mobile Communication Systems", IEEE , National Research Foundation of Korea(NRF) , pp 378-383, 2011.
[10]. Li Q, AslamJ, Rus D. "Online Power-aware Routing in Wireless Ad-hoc Networks", Proceedings of International Conf. on Mobile Computing and Networking (MobiCom'2001) 2001.
[11]. Balaswamy and K.Soundararajan(2008), "An Efficient Route Discovery Mechanism for Mobile Ad Hoc Networks", International Journal of Computer Science and Network Security, Vol. 8, No. 10, pp. 25-51.
[12].Feeney, L.M. Nilsson, M., "Investigating the Energy Consumption of a Wireless Network Interface in an Adhoc Network Environment, " Proc. of Twentieth Annual Joint Conference of the IEEE Computer and Communications Societies., INFOCOM 2001, AK, USA. Vol. 3, pp 1548-1557