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Energy Consumption Control with Slot Transition Time for Wireless Mobile Ad-hoc Network

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ABSTRACT

Wireless ad-hoc network has limited battery power. Energy consumption control is the main issue in a ad-hoc network. Node battery power is a precious resource that should be used in order to avoid the early termination of nodes. Node power consumption is reduced by vary transition time. Power control with transition time is proposed to control power consumption in mobile ad-hoc network. Simulation model has been used to analysis the energy consumption of a node. This has been achieved by estimating the time spent in each activity by a node. The proposed model has been simulated using simulator. Simulation results show significant energy savings after applying the proposed technique.

Key words: Power, Protocol, Energy, Consumption, Network
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1. INTRODUCTION

Ad-hoc networks were introduced first in military applications. Network is based on a set of nodes which dynamically communicate with each other over a wireless medium. Mobile ad-hoc networks are infrastructure less. Networks have multiple hops over wireless links. If mobile nodes are within the communication range of each other than source node can send message to the destination node otherwise it can send through intermediate node. Wireless hosts are powered by batteries which provide a limited amount of energy. One way to conserve energy is to use power control mechanisms. Power control scheme is used to reduce energy consumption by vary transmit power. Capacity of a wireless link may be degraded over time due to multi-path fading, noise, and signal interference.

Ad-hoc networks require the support of multi-hop communication schemes in order to relay massages through other hosts when there is no direct access between the sending and receiving hosts. It is difficult to determine the cost and implement a mobile ad-hoc network due to characteristics [3]. Network has number of obstacles that have to be faced in its planning [4]. The most well known power saving strategy is the IEEE 802.11 power saving mode [1]. But it is originally designed for the single hop environment, making it inapplicable to mobile ad-hoc network in which multi-hop connectivity is the most prominent feature. Tseng and Hsu have presented a Quorum-based protocol, which supports low-power sleep mode to operate across multiple hops [2].Diffusive behavior of mobile nodes should be correctly captured and taken into account for the design and comparison study of network protocols [5].It is therefore very important to set the correct constraints in order to achieve more accurate results. Simulator is used to analysis the power control in mobile ad hoc networks [6].Throughput-oriented transmission power control schemes use per-packet power control to increase the throughput. These schemes allow for concurrent transmissions in the same vicinity of a receiver by locally broadcasting collision avoidance information over a separate control channel [7]. Nodes battery is an important factor to determine the life of network. Energy consumption problem in ad-hoc network can be reduced with the help of hardware and software techniques. Scheduling packet transmission and channel assignment based on dynamic topology changes of the network. Residual battery energy capacity of node is a key design consideration in the network. Efficient utilization of the battery energy capacity has an important influence on the overall performance of the network. Uneven distribution of energy resources and computational workloads is especially harmful from the perspective or prolonging the network lifetime.

In simulation model, Energy consumption is depending on the transmission time between two hosts. In this paper Section A describes the related work and Power control algorithm and Section B describes the simulation result and conclusion.

2. RELATED WORK

Krishnamurthy et al. have described that power control and management are two mechanisms to maintain the energy consumption in mobile ad-hoc network [8]. Zawodniok et al. have introduced distributed power control scheme to use significantly less transmitter power per bit, hence the energy is saved and life-time of wireless nodes extended. Power control medium access protocol scheme is not effective due to less transmitter power per bit at high transmission rate [9]. YanChen et al. have implemented effective power allocation between the source and each potential relay in order to explore greater power efficiency at a given transmission rate. Networks are not reliable due to congestion problems[10]. A dynamical characteristic of ad-hoc networks has been studied by Pimentel et al., in which addition of more gateways improves the capacity of the network as well as its reliability, due to the more bearable the congestion condition. Gateways are not sufficient to improve network efficiency [11]. Lee et al. have focused on joint opportunistic power scheduling and

end-to-end rate control scheme for wireless ad-hoc network, which objective to increase system efficiency by controlling the power allocation of each link and the data rate of each node in the system. Network consumes more power in joint opportunistic power scheduling and end-to-end rate control scheme [12]. Charya et al. have described a method in which nodes consume more energy as compare to dynamic selection of nodes. A dynamic selection of the nodes consumes less power and the network never fails. Network performance is decreasing at high transmission rate [13]. Link distance has been considered for power savings in [14-16]. Grid-based energy aware node-disjoint multi path routing algorithm considers energy aware and node-disjoint multi path, it uses grid head election algorithm to select the grid-head. At any time each node can obtain its location information from global position system to know in which zone it is located [17]. Novel constrained entropy-based multi path routing algorithm in ad-hoc is used to construct the new metric-entropy and select the stability path with the help of entropy metric to reduce the number of route reconstruction so as to provide quality of service guarantee in the ad-hoc network [18].

3. PROPOSED POWER CONTROL TECHNIQUEWITH SLOTS TRANSITION TIME

The power control issue is one of the major problems in ad-hoc network. Protocol has a significant impact on the achievable throughput, packet delivery ratio, bandwidth delay product and packet loss in ad-hoc networks [19]. In order to be capable of receiving messages, other nodes always listen at the beginning of time slots of other nodes to find out whether they are addressed either by node ID or by broadcast address. .In the schedule based protocol, transition time (t) is organized in time slots(S), which are grouped into frames. Each frame has a fixed length of a (integer) number of slots.

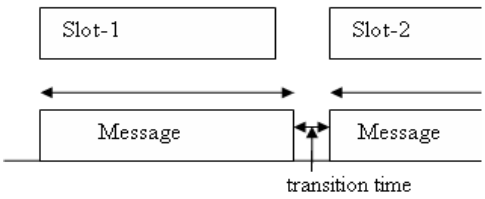

Figure1: Frame Format

Battery power Capacity(C) is a limiting factor in successful deployment of a mobile ad hoc network, since nodes are battery powered. Transceiver has limited power Pmax. to transmit and receive the signal. Power control protocol which reduces the power consumption and also increase the throughput of the network.

Proposed Relationship

Power is measure at any node to know the power consumption of node. Average power consumed by nodes may be calculated .Mathematical relationship is more effective to determine value of node power consumption for any slot with respect to transition time.

Proposed relationship between power and slot transition time for node 2 is given below.

If t=0.3s then

P=0.92*S+C----------(1)

S= Slots, C (constant) = -1.44

If t=0.4 s then

P=0.728*S+C----------(2)

C=-0.9233

If t=0.5s then

P=0.5564*S+C----------(3)

C=-0.792

Node power consumption for any value of slot may be calculated directly without simulator. For example

S=5, t=0.5 s

P=0.92*5-1.44=3.16 mw

If s=7, t=0.5s

P= 0.92*7-1.44=5 mw

If s=12, t=0.5s

P=0.92*12-1.44=9.6 mw

4. SIMULATION RESULTS

In this section, simulator is used to simulate mesh topology based network. All nodes (5 nodes) are in the range of each other to send out and receive packets. Parameters are used to measure the node battery power consumption with respect to transition time and number of slots. Parameters are used in network given below-

- Number of Slots
- Number of Nodes
- Transmitter Power
- Battery Capacity
- Simulation Time
- Slot Transition Time

Case1.

Nodes are interconnected in mesh topology. Nodes have fixed slot time. Slots are used for transmission and reception of data. Simulation result for slot transition time-0.5s given below

Node / Slots	Node Battery Power (mw)			
	5	10	15	20
Node0	3.54	8.26	12.8	17.3
Node1	3.72	8.26	12.8	17.3
Node2	3.16	7.89	12.4	16.98
Node3	4.09	8.63	12.9	17.68
Node4	2.79	7.54	11.3	16.66

Table 1: Slots vs. Power (mw)

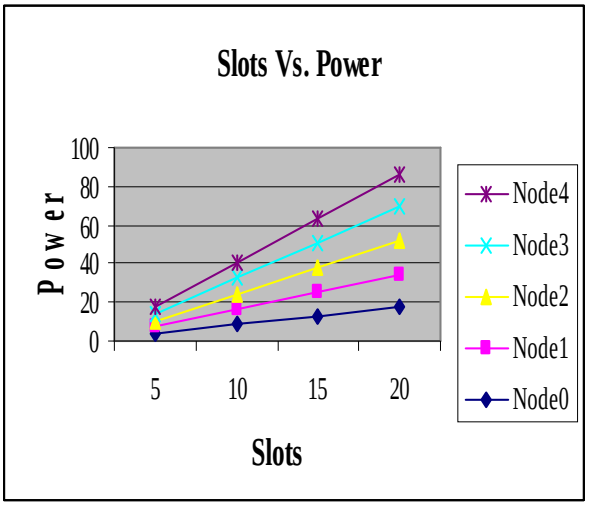

Figure 2: Graph between Slots and Power (mw)

Network has consumed17.3mw power with five slots. When time is same and numbers of slots are changed. Network has consumed 85.2mw power with twenty slots. Power is consumed more due to large active time of nodes. Network life may increased by decreasing the battery power consumption in a network.

Case2.

For transition time=0.4s

Node / Slots	Node Battery Power (mw)			
	5	10	15	20
Node0	3.09	6.66	10.29	13.92
Node1	3.02	6.66	10.30	13.93
Node2	2.72	6.36	10.01	13.65
Node3	3.18	6.96	10.59	14.21
Node4	2.28	6.08	9.74	13.39

Table 2: Slot vs. Power (mw)

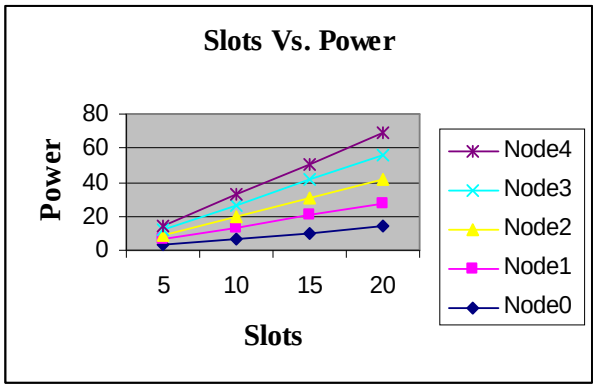

Figure 3: Graph between Slot and Power (t=0.4s)

Network with five slots has consumed14.29mw power with transition time 0.4s in a frame. Network has consumed 68.10 mw power with twenty slots.

Case3.

For transition time-0.3s

Node / Slots	Node Battery Power(mw)			
	5	10	15	20
Node0	2.34	5.08	7.81	10.54
Node1	2.22	5.08	7.81	10.546
Node2	1.99	4.85	7.602	10.336
Node3	2.57	5.31	7.92	10.758
Node4	1.77	4.64	7.29	10.143

Table 3: Slot vs. Power (mw)

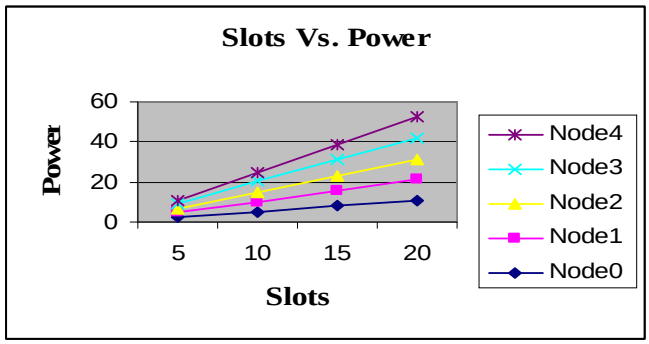

Figure 4: Graph between Slot and Power (mw)

Network with five slots has consumed 10.89mw power with transition time 0.3s.

It is observed from all tables and graphs that power consumption is depending on transmission time. Power consumption may decreased by transmission of more number of slots with less transmission time.

5. CONCLUSION

The power control is of great significance in ad-hoc networks because of their structure and lack of central management. It is seen that with the implementation of efficient power control techniques, ad-hoc networks can improve their vital parameters, such as power consumption, interference distribution, throughput, routing, connectivity, clustering, backbone management, and organization.

In this paper, Slots transition time is used to control power consumption in network. Power Simulation model is used to analysis of power consumption in mobile ad-hoc network. Power consumption is controlled by slot transition time. Network life time is increased due to less transmission time. Simulation model is the solution to analyses the optimization of power consumption for ad-hoc network.

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