Power Consumption Control Algorithm for Wireless Ad-hoc Network

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ABSTRACT

Power consumption control algorithm is required to reduce power consumption for reliable data transmission in wireless network. In order to ensure this, control mechanism affects the operational lifetime of nodes. In the current paper, power consumption control algorithm is proposed, which can improve remaining energy and increase the network lifetime. In this energy management, each node can transfer its state between two modes to save power in network. New approach is used to improve the power consumption control for wireless network.

Keywords— Power, Control, Algorithm, Transmission

I. INTRODUCTION

Wireless ad-hoc networks are based on a set of nodes. These networks are without infrastructure and have multiple hops over wireless links. Wireless hosts are powered by batteries, which provide energy for a limited period. To conserve energy, power consumption control scheme is used to reduce energy consumption by varying the transmission power. Energy consumption problem can be solved with the effective use of hardware and software techniques. Energy can be managed at various levels: component level, system level and network level. However, this scheme only minimizes the transmission power within a node’s neighborhood. Since the power of a transmitted signal is attenuated at the rate of \( 1/d^n \), where \( d \) is the distance between a sender and a receiver and \( n \) is the path loss exponent. Data packets are transmitted directly to a node may consume more energy than going through some intermediate nodes. Since the size of a mobile node is very small, it is important to explore new technique that minimizes the power consumption in transmission of data.

Power consumption control in ad-hoc networks have been the focus of extensive research due to low energy capacity of network. Power consumption also depends on the medium access layer and protocol from physical to transport layers, which selects the minimum amount of transmission energy required to exchange messages between any pair of neighbouring nodes. Transmission power consumption control includes important parameter like energy consumption. Transmission causes interference in the surrounding region due to shared nature of the wireless channel. Signal interference is reduced by reducing the transmission range, or the power level in network. Low-power level is increasing the relaying load on a node. Several medium access control protocols have been developed for wireless environments such as carrier sense multiple access, multiple access with collision avoidance IEEE802.11 and IEEE 802.11e. These MAC protocols are based on multiple design choices and utilize distinct medium access mechanisms. Modified ad-hoc on-demand distance vector algorithm is improved model of other ad-hoc algorithm. This algorithm minimizes the number of broadcast and control energy consumption by creating routes on-demand. The current paper describes related work, proposed algorithm with results and conclusion.

II. RELATED WORK

Ebert et al. have proposed new scheme which is based on reducing transmission power to save power [1]. Rodoplu et al. have described power consumption control scheme, which is used for the purpose of energy saving in large network [2]. Wu et al. have proposed power consumption control protocol, which uses one control channel and multiple data channels [3]. Tseng et al. have explained about power level at which nodes in transmission range can receive and decode packet correctly [4]. Dan Avidor et al. have proposed the distribution of the transmit power of individual nodes under different topology control algorithms to save power in network [5]. Song et al. have presented the minimal achievable broadcast energy consumption scheme to save energy in network [6]. Jang et al. have stated that joint power scheduling and rate control algorithm is used to increase the lifetime of network [7]. Mumtaz et al. have described about quality of service and power control by using node disjoint multi path routing [8]. Abusalah et al. stated that
ad-hoc networks have to meet the requirements like confidentiality, integrity, authentication, non-repudiation and availability [9]. Wu et al. have explained that adaptive searching range routing algorithm is used to reduce power consumption by adjusting the link distance in the routes [10].

III. PROPOSED POWER CONSUMPTION CONTROL ALGORITHM

Energy management is required to calculate energy consumption of nodes in a mobile ad-hoc network.

Energy Management

The evaluation of energy consumption is particularly important in a mobile ad-hoc network because a mobile node supports not just the applications that are running locally on it, but also the unpredictable demand of the network infrastructure. Ad-hoc on demand distant vector protocol is used for routing between source and destination. Routing functions are explained below:

- Route Request (RREQ), Route Reply (RREP) and Route Error (RRER) messages are used for route discovery and maintenance in network. Throughput is improved by adjusting the next hop searching range in route discovery. Link distance is adjusted according to the network load.

Algorithm is proposed to setup communication between source and destination and control power consumption. Algorithm is explained step by step below:

Step1. Initialize the nodes (set the node parameters)
Step2. Check the availability of routes in route table
Step3. If routes are available then update route table otherwise broadcast
Step4. If the current node is the destination node, it will store Ptx and the ratio of Re to Ptx. Then it adds the values to the corresponding fields of RREQ and produces RREP. The values recorded in RREQ will be copied to RREP. Finally, it begins to send RREP to the source node. Otherwise, go to next step;
Step5. Transfer message to destination node. If the current node has already forwarded RREQ, the RREQ will be deleted. Otherwise, go to next step;
Step6. Check the status of nodes. If the routing list in RREQ contains address of the current node, the RREQ will be deleted. Otherwise, go to next step;
Step7. If source node is ready then receiving node send back ready signal otherwise route maintenance and activated route repairs. Check alternate route is available in nearby node. If yes go to next step, otherwise activate route repair mechanism.
Step8. Calculate Ptx according to remaining energy and continuously forward RREQ. Once the destination node receives RREQ, it needs to select the path for responding the RREP to the source node. When a RREP is received by source node, go to next step;
Step9. If it is source node and in power-save mode, transfers it to active mode. Once RREP is received by source node, path is successfully set up.

IV. SIMULATION RESULT

Simulator is used to simulate proposed technique. In the simulation, mobile nodes move in 800 meter x 800 meter region for 100 seconds simulation time. Initial locations and movements of the nodes are obtained using the random waypoint model. All nodes have the same transmission range of 250 meters. Energy management model has main parameters like Sleep Power: power consumption in sleep state, Transition Power: power consumption in state transition from sleep to idle (active), Transition Time: time used in state transition from sleep to idle (active).

Transition Energy and Remaining Energy

In this set of simulation, node remaining energy is determined by energy consumed in transition. Proposed model have consumed less Te1 energy as compare to Te2 energy [14].

![Figure. Relation between transition energy and remaining energy](image-url)

It is observed from figure that network lifetime is increased with perfect control of transition energy.
V. CONCLUSION

In this paper, a proposal for algorithm based on optimal transmission power has been discussed. The mobile nodes start forwarding the data packets through the path which involves minimum energy. The status of every node is composed and delivered to destination node. The source transmits the data packets to the destination through the selected short path. It is observed that with the implementation of proposed algorithm, ad-hoc networks can improve their network life time.

REFERENCES