Analysis of Power Control Scheme, Routing Protocol and Link Scheduling in Mobile Ad hoc Network

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Summary
The network in case of Mobile Adhoc networks is generally poorly defined or not defined at all. This is true w.r.t. network infrastructure (e.g. base stations, fixed links, routers, centralized servers). In Such a network the data can be relayed/routed by intermediate nodes whose position keeps on changing. Mobile adhoc networks have some challenges like-Limited wireless transmission range, broadcast nature of the wireless medium, hidden terminal and exposed terminal problems, packet losses due to transmission errors-Mobility, induced route changes, Mobility-induced packet losses, Battery constraints, Ease of snooping, security problem. The power level fundamentally affects many aspects of the operation of the network which includes the throughput capacity of the network. Power control also affects the contention for the medium, as well as the number of hops and, thus, the end-to-end delay. Transmission power also affects the important metric of energy consumptions. The current paper explores the work done in the area of power control schemes, routing protocol and link scheduling from year 2004 to year 2007.

Key words:
Power control, Routing protocol, Link Scheduling

1. Introduction

The ad-hoc networks consist of a set of wireless nodes without any centralized infrastructure. Each mobile node which has an autonomous algorithm communicates with the others. They can communicate with another node through single hop or multi-hop connections if a mobile is within the radio coverage of sender or intermediate mobiles. Intermediate nodes are used to relay or forward the packet from the sender toward the receiver. The necessity of the ad-hoc networks is shown in many commercial, military, and urgent environments. Power consumption control in mobile ad-hoc networks is one of the most important issues for enabling a guaranteed Quality of Service in end-to-end transmissions [5]. The problem is complex since the choice of the power level fundamentally affects many aspects of the operation of the network [16]which include

It determines the quality of the signal received at the receiver.
It determines the range of a transmission.
It determines the magnitude of the interference it creates for the other receivers. Power control affects the physical layer.
It affects the network layer since the transmission range affects routing
It affects the transport layer because interference causes congestion .

2. Analysis of Related work

Power control scheme designed to improve power control and maximizing the network life time in mobile adhoc network.ElBatt, T. Ephremides,A.[9]Proposed a distributed power control algorithm determines the set of powers that could be used by the scheduled users to satisfy their transmissions.Each node is supported by an omni-directional antenna. This algorithm is to be executed at the beginning of each time slot in order to cope with excessive interference levels that might be developed in some slots.The proposed algorithm determines the admissible set of users that can safely transmit in the current slot without disrupting each other's transmission.The proposed algorithm objective was to pack the maximum number of transmissions that can be successfully detected at their respective receivers in each slot. Proposed algorithm was not sufficient to improve Power control in some situation. MungChiang [23] proposed a distributed algorithm for jointly optimal end-to-end congestion control and per-link power control. In order to achieve high end-to-end throughput in an energy efficient manner, congestion control and power control need to be jointly designed and distributively implemented. The algorithm utilizes the coupling between the transport and physical layers to increase end-to-end throughput and energy efficiency in a wireless multihop network.Tsenghih-Cheng Chen,Kwang-Cheng Liang,Yu-Ji a Tuan,Zhi-Wei [35] stated wireless ad hoc network requires the minimum number of cluster maintenance overheads not only reduces the waste of precious bandwidth but also conserves the consumption of the limited battery power.WeifaLiang,YangYuansheng[36]

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proposed algorithm is to maximize the load ratios of energy capacities of mobile batteries in the routing path.If the mobile nodes in an ad hoc network are equipped with different types of batteries, then the algorithms may not be able to prolong the lifetime of a node as well the entire network. The reason behind is that, if applying proposed routing algorithms, the mobile nodes with larger battery capacities may still have plenty power energy left after realizing routings for a certain number of communication requests, whereas the mobile nodes with smaller battery capacities may have drained out whole their energy already, because each mobile node in the routing path reduces its transmission energy at the same rate without taking into account of its original capacity. To overcome this drawback incurred by the heterogeneity of the batteries.Zawodniok ,M.Jagannathan,S.[41]proposed a distributed power control MAC protocol for wireless ad hoc networks. The objectives of transmitter power control include minimizing power consumption while increasing the network capacity and prolonging the battery life of mobile units by managing mutual interference so that each mobile unit can meet its signal-to-interference ratio and other quality of service requirements. The proposed protocol, only the initial RTS-CTS frames during link set-up have to be transmitted using maximum power defined by the link. Subsequently all frames, including RTS-CTS-DATA-ACK frames, will use transmission power calculated according to the proposed DPC scheme. Kwon Dong-HoCho [18] purposed asynchronous power management scheme for wireless ad-hoc networks to reduce power consumption in wireless networks is to use the LOW-Power Mode .In other words, if the terminal neither transmits nor receives the packet during the certain period, the terminal is allowed to change to LPM which can't transmit and receive. Kawadia, V.Kumar, P.R. [16] stated power control problem in wireless ad hoc networks is that of choosing the transmit power for each packet in a distributed fashion at each node.A simple solution for power control is the COMPOW protocol.In COMPOW, the goal of the optimization for each node is to choose 1) a common power level; 2) set this power level to the lowest value which keeps the network connected; and 3) keeps the energy consumption close to minimum COMPOW protocol were not useful in some application.Ruffini,M. Reumerman,H.J[28]have proposed a solution for the power and rate adaptation problem for ad-hoc wireless network when high mobility is considered. The reduction of the interference generated by the transmission by means of processing information related to packet length and knowledge of the neighborhood topology.The proposed solution was not sufficient in some situation. SongGuoYang,O [32] said that When power efficiency is considered, ad hoc networks will require a power-aware metric for their routing algorithms. Main optimization metrics for energy-efficiency broadcast /multicast routing in wireless ad hoc networks:(1)maximizing the broadcast/ multicastlifetime(2) minimizing the total power assigned to all nodes in the broadcast /multicasttree.YanChen,GuandingYu,Peiliang ,Qiu,Zhaoya ngZhang.[39].Proposed power-aware relay selection (PARS) strategies in the purpose of maximizing the network lifetime. The main idea of the PARS strategies that optimal power allocation between the source and each potential relay is added in order to explore greater power efficiency at a given transmit rate level.RazaNaqvi,S.H.Patnaik,L.M.[27]stated power as one of the critical resources in the network,the policies for distributed allocation of power are classified as incremental or global. A power allocation policy is called incremental if it allocates the power to the incoming links without adjusting the power of the existing links.Whereas in the global power allocation policy, the power to the incoming link is allocated by adjusting the power of the existing links and, thus, the admissibility of the incoming link is decided globally.JinhuaZhuChunmingQiaoXinWang [14] proposed more accurate models to estimate the energy cost due to different factors. The energy consumption models (1) Total transmission Power Model: This model simply sums up the transmission power of the data packet at each link.(2) Total transceiving Power Model: As the intermediate nodes consume energy not only when forwarding packets but also when receiving packets. (3) Total reliable Transmission Power Model: If a data packet is lost during transmission over one link, such packet has to be retransmitted , which will consume some extra energy. Therefore, this mode includes the energy consumption for both the new data packet and the retransmitted packet. Z, J.Campbell, A.T. [40]said design of packet radios and protocols for wireless ad hoc networks is primarily based on common range transmission control.Acharya,Tamaghna Chattopadhyay,SamiranRoy, Rajarshi[1] said routing based on our algorithm for multiple disjoint power aware connected dominating sets shows better performance compared to our early proposal in terms of following parameters: (i) maximizing routing task (ii) minimizing energy consumption per routing task (iii) extending node lifetime.Chou,Zi-Tsan [8] developed power saving techniques mainly for**,** Simulatiedium access control (MAC) to prolong the network lifetime. Mavromoustakis,C.X. [24]have proposed an association of the power consumption control with some crucial metrics for Quality of Service in mobile ad-hoc networks.

3. Interference reduce the transmitted power level in mobile adhoc network.

There is a need for designing minimum energy consumption routing protocols that ensure a longer battery

life in mobile adhoc network.WenruiZhaoAmmar,M.Zegura,E.[37] stated that performance of wireless ad hoc networks is often limited by the broadcasting nature of the wireless medium, which results in interference when nearby nodes attempt to simultaneously transmit.They described the network models, traffic models and defined the energy-limited capacity.A network models consist static networks, homogeneous networks and hybrid networks. In homogeneous networks, nodes rely on their own resources for communication and no infrastructure support exists.Hybrid networks consist of base stations as well as normal nodes as in homogeneous networks.In energy model-to conserve energy, nodes may use different radio ranges in data transmission.Zheng,VincentWenchen Zhang, Xinming Liu,DaokeSung,DanKeun.[43] developed a joint Power control, link Scheduling and Rate control algorithm for wireless ad hoc networks by using the convex optimization theory. This algorithm practically considers the power control problem in the interference-based link scheduling process, and provides a congestion control on the transpor layer. Alsalih,W.Akl,S.Hassancin,H.[2]proposed a cooperative computing approach that tackles the problem of energy capacity and processing power limitations over MANETs. Mobile computing devices involved in a MANET can cooperate in running computational tasks in such a way that conserves energy and improves processing performance through the deployment of a remote execution platform and the use of an efficient energy-aware scheduler.The energy aware scheduler was not successful in some application. Zhensheng Zhang [44] purposed Directional transmission and reception algorithms in WLANs with directional antennas for quality of service support. Directional antennas provide longer transmission range and higher data rate, and reduce signal interference in unnecessary directions as well as jamming susceptibility, and lower probability of detection (LPD).Nigara,A.Blum,R.[24] said that terminals (nodes) in these networks act in a distributed fashion, and therefore must share a common RF channel.If one node is allowed access to the shared RF channel, its neighboring nodes must remain silent to avoid interference. This is an important distinguishing characteristic of adhoc networks because, not only are bandwidth, power, time, etc. resources, but so is space itself. Idea was not practical in some cases. Tae-SukKim,Seong-Lyun Kim [34] said that interference-limited wireless network, handling interference via efficient power control is one critical factor that determines the capacity of the network. The power control has been also used to control data rates, as well as to control power consumption of mobile terminals.Alsalih ,W.Akl,S.Hassanein,H.[3] proposed a cooperative computing approach that tackles the problem of energy limitation over MANETs.Mobile computing devices involved in a MANET can cooperate in running computational tasks in such a way that conserves energy through the deployment of a remote execution platform and the use of an efficient energy aware allocation algorithm. Energy-aware task allocation algorithm tries to minimize the total consumed energy by assigning each task to the processor that executes it with the minimal energy .Wu,Y.Chou,P.A.Sun-Yuan Kung [38]considered the problem of minimum-energy information multicast, namely transmitting common information from a source node to a set of destination nodes with the minimum amount of total consumed energy per information bit. The minimum energy required to transmit one bit of information through a network characterizes the most economical way to communicate in a network.The minimum energy-per-bit can be attained by performing network coding. Compared with conventional routing solutions, network coding not only allows a potentially lower energy-per-bit to be achieved, but also enables the optimal solution to be found in polynomial time.SongGuoYang,O [32] presented a constraint formulation for the minimum-energy multicast problem in wireless ad hoc networks with adaptive antennas.When power efficiency is considered, ad hoc networks will require a power-aware metric for their routing algorithms.There are two main optimization metrics for energy-efficiency broadcast/multicast routing in wireless ad hoc networks:1)maximizing the broadcast/ multicast lifetime 2) minimizing the total transmission power assigned to all nodes in the broadcast/multicast tree.The performance of algorithm D-MIP can be improve by using a new heuristic algorithm called D-MIDP(Directional Multicast Incremental-Decremental Power).The D-MIDP algorithm first constructs a broadcast tree based on the minimal incremental power of adding a new node.Li,F.Wu,K.Lippman,A.[21] purposed energy-efficient cooperative routing in multi-hop wireless ad hoc networks ,with multi-hop wireless ad hoc networks, messages may be transmitted via multiple radio hops, and thus a routing protocol is essential for the success of such networks transmissions from multiple transmitters to one receiver simultaneously.JianweiHuangBerry,R.A.Honig,M.L.[13]said interference is a fundamental problem in wireless networks.A basic technique for this is to control the nodes' transmit powers. JialingZhengMa,MYan ZhangZhenhaiShao Fujise,M.[12] stated that Interference-limited wireless network, handling interference via efficient power control is one critical factor that determines the capacity of the network.ChiWangHong-ZuChou DavidS.L.WeiWei,D.S.L[7] explained that communication functionality, a fundamental question is how much information a wireless network can transport Fundamental bounds on the gain of data availability induced by

replication, rather than propose new replication strategies for multi-hop networks. Hasan,A.Andrews, J.G. [11]proposed a concept of a guard zone that maximizes the transmission capacity for spread spectrum adhoc networks is derived – narrowband transmission is a special case. Kao,Jung-ChunMarculescu,Radu[15] presented a branch-and cutorcutting planes techniques.The optimal solutions can be used to assess the performance of heuristic algorithms by running them at discrete time instances.Chih-ChengTseng,Kwang-Cheng Chen [6] obtained the relationships between transmission range, service area and network connectedness.They said that it is contradiction between power conservation (shorter transmission range is preferred) and network connectivity (longer transmission range is preferred) in designing wireless ad hoc network. They proposed a solution to compromise these two issues. For a wireless ad hoc network to be connected, it is necessary to prevent the generation of isolated nodes since the isolated nodes partition the entire network into set of independent and disconnect sub-networks.

4. Topology control improve the power level in mobile adhoc network.

Avidor,D.Mukherjee,S.Onat,F.A.[4]said topology control adjusting the transmit power of each node independently so as to optimize certain performance measures, such as throughput, connectivity, life span of networks of battery powered nodes , simplifying the routing algorithms, etc.. PKrunz,M.Muqattash,A.Sung-JuLee[26] said MANETs can conserve battery energy by delivering a packet over a multihop path that consists of short hop by-hop links.. TPC has great potential to improve the throughput performance of a MANET and simultaneously decrease energy consumption. Pimentel,H.Pd.B.Martins,J.A. [25] said six different topologies having around 50 nodes were analyzed. As the number of simultaneous streams added to the network increase, route congestion starts and bottlenecks can be identified specially close to the gateways. Delay, as well as the number of dropped and lost packets also increases.

5. Power scheduling is more effective as compare to topology control,routing protocol and Power control scheme to ensure a maximize network life in mobile adhoc network.

Power scheduling also effect power level in mobile adhoc network.There is a need for designing minimum energy consumption routing protocols that ensure a longer battery life in mobile adhoc network Shen,Yuxiu Zhang,YingJun Wong,Wing Shing [31]proposed a generalized framework for the optimal TDMA link scheduling in multi-hop wireless adhoc networks with general topology and traffics. The per-link data rate is a function of the actual SINR of the link. This makes the link scheduling problem much more challenging, because now per-link data rate changes with scheduling decision. ZhangQing,ChenFan, YangXuemin,SheZhishengNiu[42]said there are two main classes of opportunistic transmission. The first is to exploit time diversity of an individual link by adapting its transmit rate to the time-varying channel condition . Second, with the shared wireless medium, co-channel interference has a deep impact on rate selection and flow scheduling in wireless ad hoc networks.LeeJ.-W.Mazumdar,R.R.Shroff,N.B[19] developed a joint opportunistic power scheduling and end-to-end rate control algorithm in which each user adjusts its data rate based on feedback from the system, and the system allocates transmission power to each link.Sen,Jaydip Chowdhury,Piyali Roy Sengupta,Indranil [29]presented a distributed trust establishment scheme for ad hoc networks where a trust initiator is introduced in the boot strapping phase of the system to initiate the process of trust establishment. With the help of the trust initiator, sufficient trust relation ships are established so that any pair of nodes in the network can authenticate each other with a very high probability via a trust chain. Khadar,FadilaSimplot-Ryl,David [17] stated Ad hoc networks are are really different from traditional networks and bring new challenges. They are auto-organized, which means centralized solutions for routing for instance cannot be used. They need the conception of new network protocols that taken to account this specificity.Liang,C.Dandekar,K.R. [20]stated that increasing demand for wireless services, the efficient use of spectral resources is of great importance .Multiple Input Multiple Output (MIMO) communication systems hold great promise in using radio spectrum effi-ciently while power control will improve efficiency.Elhadef,MouradBoukerche,Azzedine.[10]proposed failure detection scheme. They said distributed failure detection service can be used by distributed applications directly, or support other middleware services such as system management, load balancing and group communication and membership services. As such,failure detection is a valuable extension to current dependable services that a wireless environment is expected to provide.

6. Conclusion

In this paper, we anlysised the power management scheme ,interference problem, topology control and link scheduling problem in Ad-hoc networks. Need new

algorithm to improve power control. We have to design the new scheme after analysis of relationships between transmission range, service area and network connectedness to improve power control .Algorithm designed and developed were not sufficient to shortout power control problem and link scheduling in adhoc network. Power control effect the performance of whole network..

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