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PERKING UP THE NETWORK CAPACITY OF MANETS: A REVIEW

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***Abstract*— The Wireless ad-hoc network has dissimilar civilian and defense applications and that's why it has gained substantial attention in recent days. The major consideration in inventing such a network is to diminish power utilization because of the truth that wireless nodes are usually charged by batteries barely. Topology control is one of the chief energy preserving practices which has been mostly considered and utilized in ad-hoc wireless network. Topology control method permits each and every wireless node to choose certain subset of neighbors and extend network connectivity by consuming the lowest amount of transmission power. In this paper we review the different techniques used to improve the network capacity of MANETs with supportive communications.**

***Index Terms*— Supportive Communication, MANET, Ad hoc Network, Topology Control**

I. INTRODUCTION

The network topology in a mobile ad hoc network is changing vigorously due to traffic, user mobility, node batteries, etc. In the meantime, the topology in a mobile ad hoc network is controllable by adjusting some parameters such as the channel assignment, transmission power, etc. Generally, topology control is such a method to decide where to deploy the links and how the links work in wireless networks to create a superior network topology, which will optimize the, the capacity of the network, energy expenditure or end-to-end routing performance. Topology control is initially developed for mobile ad hoc networks, wireless sensor networks and wireless mesh networks to diminish energy consumption and interference. It typically results in a simpler network topology with small node degree and short transmission radius, which will have high-quality links and less disputation in medium access control layer. Spatial/spectrum reuse will turn feasible due to the smaller radio coverage. Other properties similar to symmetry and planarity are expected to attain in the resulting topology. Symmetry can assist wireless communication and two-way handshake schemes for link acknowledgment while planarity boosts the possibility for parallel transmissions and space reuse.

II. MINIMUM COST TOPOLOGY CONSTRUCTION TECHNIQUES

Wireless sensor networks are frequently used to verify and give statements about the locations of moving objects. As sensors are used for storage, a wireless sensor network can be taken as a distributed database, which allows updating and querying the location information of moving objects. Many researchers have examined the problem of how to build message- pruning trees that can update a database and query objects with minimum cost (the Minimum- Cost Message-Pruning Tree problem).

Quanhong Wang et al., [1] explored the setback of relay node placement in heterogeneous WSN and formulated a generalized node placement optimization problem aimed at minimizing the network cost with constraints on lifetime and connectivity. Depending on the constraints, two representative scenarios of this problem are explained. The first problem is characterized as a minimum set covering setback, where relay nodes are not energy limited. It then considered a more challenging situation, where all nodes are energy limited. Since an optimal solution to this problem is hard to achieve, a two-phase approach is proposed, where locally optimal design decisions are taken. The First Phase Relay Nodes (FPRN) placement is straightly linked to Sensor Nodes (SN), in which it is modeled as a minimum set covering problem. To check the conveying of the traffic from the FPRN to the base station, three heuristic schemes are planned to set the Second Phase Relay Nodes (SPRN). Moreover, a lower bound on the minimum number of SPRN needed for connectivity is provided.

UyenTrang Nguyen et al., [2] presented a simulation- based performance comparison of Shortest Path Trees and Minimum Cost Trees in wireless mesh networks, using performance metrics, such as packet delivery ratio, end-to-end delay, and traffic impacts on unicast flows in the same network. The minimum energy needed to convey one bit of information through a network describes the most economical way to communicate in a network. Wu et al., [3] showed that, under a layered model of wireless networks, the minimum energy-per-bit for multicasting in a mobile ad hoc network can be found by a linear program; the minimum energy-per-bit can be attained by performing network coding.

Tehuang Liu et al., [4] attempted the multicast problem with the consideration of the interference between multicast trees in Multi-Radio Multi-Channel Wireless Mesh Networks (MR-MC WMNs). A dynamic traffic model is regarded, that is, multicast session requests appear vigorously without any prior knowledge of future requests. Every node in the network acts as a Transit Access Point (TAP), and has one or multiple radios adjusted to non-overlapping channels. It is verified that in MRMC WMNs, the Minimum Cost Multicast Tree (MCMT) problem, that is, discovering the multicast tree with minimum transmission cost, is NP-hard. It is further formulated that the problem by an Integer Linear Programming (ILP) model is to work out optimally, and plan a polynomial-time near-optimal algorithm, called Wireless Closest Terminal Branching (WCTB), for the MCMT problem.

Sarkar et al., [5] proposed and investigated the characteristics of the Delay-Aware Routing Algorithm (DARA) that minimizes the average packet delay in the wireless front-end of a WOBAN. In DARA, wireless routers are modeled as queues and envisage wireless link states occasionally. Therefore, it reveals that DARA gains less delay and congestion, and enhanced load balancing by comparing traditional approaches like the minimum-hop routing algorithm, shortest-path routing algorithm, and prognostic throughput routing algorithm.

III. Energy Reduction Techniques

A theoretical framework is proposed by Fischione et al., [6] for accurate comparison of minimum energy coding in Coded Division Multiple Access (CDMA) wireless sensor networks (WSNs). Energy consumption and reliability are investigated for two coding schemes: Minimum Energy coding (ME), and modified Minimum Energy Coding (MME). A complete model of consumed energy is defined as function of the coding, radio transmits power, the uniqueness of the transceivers, and the dynamics of the wireless channel. As CDMA is perfectly limited by multi-access interference, the system model contains all the appropriate characteristics of wireless propagation. To reduce the total energy consumption b y managing the radio power, a distributed and asynchronous algorithm is generated. Several results are shown to authenticate the theoretical analysis and explain under which conditions MME outperforms ME with respect to energy consumption and bit error rate. It is concluded that MME is more energy efficient than ME only for short codewords. MaxWeight algorithm, also known as back-pressure algorithm, has gained much interest as a feasible solution for dynamic link scheduling in multi-hop wireless networks. The basic function of the MaxWeight algorithm is to choose a set of interference-free links with the maximum overall link weights in the network, where the link weight is determined by the queue distinction among the transmitter and the receiver. Whereas the throughput-optimality of the MaxWeight algorithm is understood well in the literature, the energy consumption persuaded by the MaxWeight algorithm is less examined, which is of huge interest in energy-constrained wireless networks, for example, wireless sensor networks. Yang Song [7] proposed a Minimum Energy Scheduling (MES) algorithm for multi-hop wireless networks with stochastic traffic arrivals and time-varying channel conditions.

It is revealed that this algorithm is energy optimal such that the planned MES algorithm can attain an energy consumption which is randomly close to the global minimum solution. Furthermore, the energy effectiveness of the MES algorithm is accomplished by not losing the throughput-optimality. Also, the proposed MES algorithm is still optimal while the average consumed energy in the network is considerably decreased, when related to the traditional MaxWeight algorithm. Rodoplu et al., [8] described a distributed position-based network protocol optimized for minimum energy consumption in mobile wireless networks that support peer-to-peer communications.

Jain et al., [9] proposed scaling laws for maximal energy efficiency of communicating a message to all the nodes in a wireless network, as the number of nodes in the network becomes large.

Song Guo et al., [10] presented a constraint formulation for the MEM (Minimum- Energy Multicast) problem in terms of MILP (Mixed Integer Linear Programming) for wireless ad hoc networks. A finest solution to the MEM problem using MILP model can always be achieved in a timely manner for fairly sized networks. Additionally, by the theoretical effort, two polynomial-time heuristic algorithms are presented: RB-MIDP and D-MIDP to handle larger networks for which the MILP model may not be computationally efficient.

Liqi Shi et al., [11] proposed a solution to the scheduling problem in clustered Wireless Sensor Networks (WSNs). The goal is to give network-wide optimized Time Division Multiple Access (TDMA) schedules that attains high power efficiency, zero conflict, and reduced end- to-end delay.

IV. Aggregate Capacity For Self Organization

Wireless mobile communications will be decided by converged networks that combine disparate technologies and services in the future-generation. The wireless mesh network is predicted to be one of the key components in the converged networks of the future, giving flexible high- bandwidth, wireless backhaul in the huge geographical areas. While single radio mesh nodes operating on a single channel undergo from capacity constraints, equipping mesh routers with multiple radios using multiple nonoverlapping channels can considerably alleviate the capacity problem and enhance the aggregate bandwidth available to the network.

Nevertheless, the assignment of channels to the radio interfaces poses important challenges.

The goal of channel assignment algorithms in multiradio mesh networks is to reduce interference while enhancing the aggregate network capacity and maintaining the connectivity of the network. Skalli et al., [12] examined the unique constraints of channel assignment in wireless mesh networks and identified the key factors governing assignment schemes, with particular reference to interference, traffic patterns, and multipath connectivity. Subsequently presenting taxonomy of existing channel assignment algorithms for WMNs, it determines a new channel assignment scheme called MesTiC, which combines the mesh traffic pattern mutually with connectivity issues to reduce interference in multi-radio mesh networks.

Pinto et al., [13] presented a mathematical model for communication subject to both network interference and noise, where the interferers are scattered according to a spatial Poisson process, and are operating asynchronously in a wireless environment subject to path loss, shadowing, and multipath fading. The delivery of the aggregate interference is resolved and the error performance of the link. The capacity of the link focus to both network interference and noise is described. Further it forwards the concept of Spectral Outage Probability (SOP), a novel description of the aggregate radio-frequency emission produced b y communicating nodes in a wireless network. Some of the functions of the SOP, that is, the organization of spectral regulations and the plan of covert military networks are presented.

The proposed framework details all the essential physical parameters that influence the aggregate network emission, which is sufficient to give insights that may be worth in the design and deployment of wireless networks.

ShaoleiRen et al., [14] focused on the users' aggregate data demand dynamics in a wireless communications market served by a monopolistic Wireless Service Provider (WSP). Depending on the equilibrium data demand, it is optimized that the WSP's data plans and long- term network capacity decides to increase its profit. Initially, by considering a market where only one data plan is offered, it reveals that there exists a single equilibrium in the data demand dynamics regardless of the data plans, and that the meeting of data demand dynamics is subject to the network congestion cost, which is closely related to the WSP's long-term capacity decision. An enough condition on the network congestion cost designates that the WSP needs to give a sufficiently large network capacity to assure the convergence of data demand dynamics. A heuristic algorithm is also planned that gradually optimizes the WSP's data plan to increase its equilibrium revenue. Secondly, it revolves to a market where two different data plans are offered.

V. Minimizing Interference of The Wireless Networks

In wireless communications, [15] the preferred wireless signal is typically decoded b y treating the total of all the other continuing signal transmissions as noise. In the networking literature, this phenomenon is naturally abstracted utilizing a wireless channel interference model. The stage of detail in the interference model, obviously decides the correctness of the results based upon the model. Numerous works in the networking literature have utilized simplistic interference models, for example, permanent ranges for communication and interference, the confine threshold model (utilized in the ns2 network simulator), the protocol model, and so on.

Gomadam et al., [16] provided examples of iterative algorithms that utilize the reciprocity of wireless networks to achieve interference alignment with only local channel knowledge at each node. These algorithms also offer numerical insights into the possibility of interference alignment that are not yet accessible in theory.

Interference due to diffusion by adjacent nodes in a multi-hop wireless network can be represented using a Unit Disc Graph (UDG). Mani et al., [17] investigated the reliability associated with using the clique number instead of the chromatic number of the UDG while computing the interference.

In the extensive replications with UDGs of random networks, it is observed that the clique number and the chromatic number values were normally very close to one another and the maximum deviation was very less than the theoretical bounds. This involves very high reliability in the proposed estimation. Joint design and optimization of conventionally independent problems like routing and link scheduling have newly become one of the most important research trends in wireless mesh networks. Even though technically challenging, cross-layering is, actually, likely to bring important benefits from the network resource exploitation standpoint to attain high system utilization. Badia et al. [18] proposed a versatile framework for joint design of routing and link scheduling, introducing the notion of link activation constraints, which are related to the transceiver capability and the broadcast nature of the wireless medium.

Finally, taxonomy of wireless interference models is initiated to complement existing approaches presented in the literature. In conclusion, the impact on network capacity is estimated of the different interference models when optimal joint routing and link scheduling are occupied. The difficulty of proportional fairness in interference coupled wireless systems is re-examined. It represents interference combination in wireless systems based on an interference function framework throughout a set of axioms. It uses the collective choice function to characterize resource allocation strategies and an axiomatic framework to imitate certain desirable properties of resource allocation strategies. Boche et al., [19] introduced the axiom of equal priority in the power domain (and in the interference domain) and motivated it as interference coordination fairness. It considered this as anonymity between the users, from the perception of a central controller, for example, a base station or an operator. Therefore it reveals that the proportional fair resource allocation strategy is unknown to the identity of the users at the signal processing layer.

VI. Conclusion

Topology control is a method used in circulated computing to modify the underlying network (modeled as a graph) in order to decrease the cost of distributed algorithms if run over the new resulting graphs. It is a fundamental procedure in distributed algorithm. In this paper we reviewed the different techniques used to improve the network capacity of MANETs.

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