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Capacity-Aware Control Topology in MANET

By Madhusudan G & Kumar TNR

Abstract- The wireless mobile adhoc networks are dynamically Varying, the network performance may change by different unknown parameters such as the total number of nodes in the network, the transmission power range of the network and area of deployment of the network. The main aim is to increase the efficiency of the system through dynamically changing the trasmission range on every node of the network. contention index is the network performance factor is considered. we presented a study of the effects of contention index on the network performance, considering capacity of the network and efficiency of the power. The result is that the capacity is a concave function of the contention index. if the contention index is large the impact of node mobility is minimal on the network performance. we presented GridMobile, a distributed Network topology algorithm that attempts to shows the best possiblity, by maintaining optimal contention index by dynamically adjusting the transmission range on every nodes in the network

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Capacity-Aware Control Topology in MANET

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I. Introduction

Manet is infrastructure less collection of mobile nodes with multi hop network gives fast network establishment, that communicate over relatively bandwidth constrained wireless links [13] [14]. Mobile Ad-Hoc Networks (MANETs) represent an interesting substrate for many types of applications that do not require a fixed network infrastructure (Access Points) [11].The combination of wireless communications such as new technology is in diversity wireless bandwidth and increase in reliability. The adjustment of transmission power through the dynamic transmission power control protocol is an effective technique to reduce the power consumption of a network [15] [16]. The conventional broadcasting information to direct source-destination signal, while cooperative communication [1][2] to take advantage of user diversity combined signal decoding the source destination signs direct and relayed signals of interest. It is challenging to develop robust routing protocol for dynamic Mobile Ad Hoc Networks (MANET). Geographic routing protocols [7] [8] are generally more scalable and reliable than conventional topology-based routing protocols [9] [10] with their forwarding decisions based on the local topology. The Selection of proper relay transmission rate can maximize reliability [10]. The mathematical model will derives the relationship between energy consumption and node transmission power ranges, if the adhoc network is stationary without mobility of the nodes of the network. This model may be used to optimize the topology to conserve less power. But the transmission power range is not a independent component that affects power efficiency and network capacity. The changing number of nodes in the network and the physical area of deployment plays a major role in adhoc networks. In order to identify one single parameter in controlling the network performance, The term contention index, plays a major role in adhoc network. The contention index means the number of contending nodes within the interference range. In this work, the term contention index, rather than the transmission power range on each node, is the important and independent driving force that influences the network performance. The results of the simulation shows that the network capacity is a concave function of contention index. The optimal values of contention index will achieve the best possible performance. Base on the performance evaluation of simulation results, we propose *GridMobile*, Capacity-aware control topology algorithm is used to ensure that the every node in a mobile adhoc network adjusts the transmission power ranges to maintain optimal contention index which may lead to a topology that yields optimal performance in terms of network capacity and power efficiency. The network is stationary, with uniform node density and fixed transmission power ranges. Previous studies on capacity of wireless networks have been reported in [5], [6]. It has been shown that the per-node capacity may be estimated in the order of $O(1/\sqrt{n})$, n being the number of nodes in the network. However, the compensating effects of local per-node transmission range an adjustment on the network performance has yet to be studied [3].

We formally define the contention index as the within the transmission power range, The total number of network nodes avialable, B*ut* the interference range is differnt. The parameter is referred to as the contention index, since it represents the potential congestion level in the local neighborhood of the network. For the Open System Interconnection medium Access Control protocol, we assumed that the transmission ranges of all nodes are identical. The contention index is related to three parameters in the simulation setup: (i) the total number of nodes n; (ii) the physical area of deployment of the network L^2 (iii) the node transmission power range[3] Naturally, when there are more nodes in the network, the contention in the network increases. Each node adopts a larger transmission range, or decreeasing size of the network area. With the node density D calculated as n/L^2, the contention index, CI, is

Author α: Asst. Professor, Department of CS & E, SJCE, Mysore.
e-mail: madhusudan@sjce.ac.in
Author σ: Asst. Professor, Department of CS & E, MSRIT, Bangaluru.
e-mail: tnrkumar@msrit.edu

Global Journal of Computer Science and Technology (E) Volume XVII Issue IV Version I Year 2017

the product of node density and area of the network size of local transmission range:

$$CI = D\pi R^2 = n\pi R^2 / L^2 \qquad (1)$$

We vary the contention index in the performance evaluations as a primary driving force, in order to measure its impact on the performance of the network in terms of network capacity and power efficiency[3].

In dense network when two nodes are close to each other, a low transmission power is sufficient for communication [17].

MANET applications include supporting battlefield communications, emergency relief scenarios, law enforcement, public meeting, virtual class room, and other security-sensitive computing environments. The ad-hoc networking technology has stimulated substantial research activities in the past years [12].

II. MobileGrid

MobileGrid is the nodes in mobile ad hoc networks to make fully localized decisions on the optimal transmission range to maintain an optimal contention index, so that the network capacity is optimized. The node can estimate the contention index by knowing how many neighbors a node has. Based on this observation, The distributed topology control algorithm, called GridMobile, is implemented as a three-phase protocol, executed at each node periodically (by the end of each time window) to accommodate node mobility.

The different phases to be followed in the implementation are as follows:

Phase 1: Estimating Contention Index: with its current transmission power (or maximum power at 0^n time window) a node starts to discover its neighbors at the MAC layer by hearing both control (e.g. RTS/CTS/ACK) and data messages. Since the header of each message contains the source node ID, the node may compute the number of unique node IDs that it may overhear over the time window. Such a set of unique node identifiers forms the set of neighbors that the node may find. Such a passive approach does not introduce additional overhead to the existing network traffic. Tthe nodes may not be able to detect "silent" nodes in the neighborhood that did not transmit any control or data messages. We argue that, since such silent nodes did not inject network traffic in the current time window, the possibility that they start to transmit in the next time window is low. In this case, the calculation of contention index may safely ignore such nodes. If the discovered number of neighboring nodes is N, the estimated contention index CI is N + 1.

Phase 2: Looking up Optimal Values of the Contention Index if the system operating around an optimal value of contention index, Each node looks up in a particular optimization table to determine the table stores optimal values of contention index to maximize the network capacity, which it may obtain from off-line experiments using identical physical, Medium Access Control routing layer characteristics and parameters. Since the optimal contention index is an inherent property that does not vary much when changing node mobility, we may safely assume that such an optimization table may not need to be updated frequently. With respect to an interested QoS parameter such as network capacity, if the contention index it has estimated from the first phase does not fall into the specific optimal range in the table, the node proceeds to the next phase to adjust its transmission range. Otherwise, the current transmission range is adopted for the next time window.

Phase 3: Transmission Range Adjustments: In the second phase, each node decides that its current transmission range is not optimal by a table look-up, uses the following scheme to eventually keep it checked within the range of optimal contention index values. If the contention index *CI* calculated in the first phase is out of the optimal range in the optimization table (either smaller than the lower bound or higher than the upper bound), the node tunes the transmission power *R* as illustrated in Equation: Rnew = min(√CI optimal/CI current Rcurrent,Rmax)where *R*max is the maximum transmission range decided by the physical layer and radio characteristics, and CI optimal is chosen as the median point of the optimal range in the table.

This scheme guarantees convergence towards either the maximum range *R*max, or the optimal range of contention indices, whichever appears earlier.

III. Experiments on The Mobile Grid Algorithm

In order to evaluate if Grid *Mobile* works as effective as the centralized solution in previous performance evaluations, we use a snapshot of a wireless adhoc network in an area of 350 meters by 350 meters where each node's maximum transmission range is 200 meters. The number of nodes in such a network varies from 20 to 200. Network capacity is chosen to be optimized and the optimal contention index *CI* is set to be 6. Both the average transmission power and standard deviation of transmission powers are measured in the experiments, where average transmission power is calculated as the sum of transmission powers at each node divided by number of nodes in the network. The standard deviation of transmission powers is calculated to demonstrate how diverse the transmission ranges among all network nodes are. Figure below 3.1 (a) demonstrates the respective average transmission range in the resulted topology based on the centralized solution and MobileGrid algorithm. We result is that the two curves are very close to each other, which means that GridMobile performs nearly better as compared to the centralized solution. Furthermore, this results does not change with the total number of nodes in the network. In the centralized solution, all nodes are supposed to adopt a uniform transmission. Hence, in Figure below 3.2.(b) the curve for the centralized solution is flat with values of 0. However, in GridMobile, the standard deviation of transmission powers is always positive because the network is not evenly distributed, different nodes adopts different powers to cover the same number of neighboring nodes. As we may observe, the standard deviation of transmission powers tends to decline with the large number of nodes in the network. The results are considered comparing the centralized solution and GridMobile, Considering the parameters Average Transmission range and Standard Deviation of Transmission ranges. The Graph shows that the GridMobile Technique provides better solution compared to Centralized solution [3].

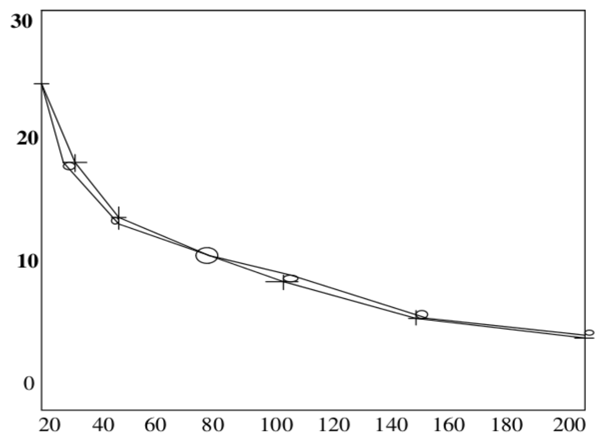

Fig 3.1: (a) Centralized Solution vs. GridMobile

(Average Transmission Power)

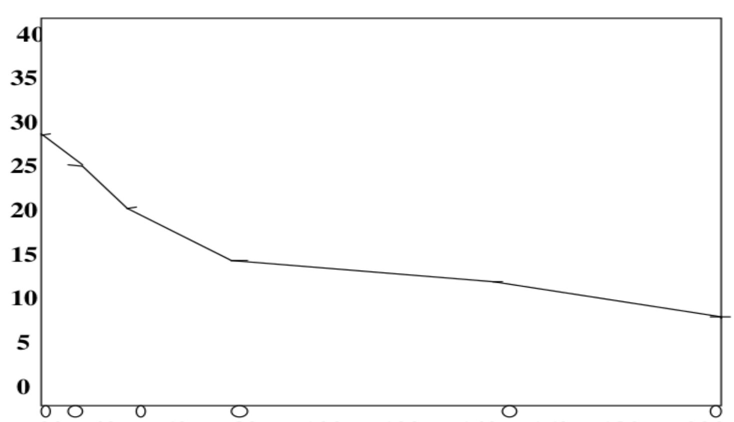

Fig 3.2: (b) Centralized Solution vs. GridMobile

(Standard Deviation of Transmission Power)

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IV. Conclusion and Future Work

We introduced an interesting important parameter, contention index, in mobile ad hoc networks. With extensive performance evaluations, it is found that the contention index is the primary factor force that influences the network performance with respect to network capacity and power efficiency of the network. Furthermore, Maximum values of the contention index do exist to optimize the network performance. GridMobile, a distributed topology control algorithm, is introduced to ensure optimality regarding the contention index. It is proved to be effective by the simulation results.

Futute works comprises considering different parameters of the network constriants, the system is campared with the same parameter contention index.

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