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### **RESEARCH ARTICLE**

# **MAC 802.11 Protocol with Dynamic Bandwidth Allocation for Data Transmission in Network**

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*Abstract: Medium access control protocols and its effect on capacity are important aspects in communication system design for any shared medium like wireless. In multi-hop ad hoc networks that use a distributed and contention based channel access mechanism such as those specified in the IEEE 802.11 standard, the capacity of individual links are not known. Existing methods in literature attempt to solve this using measurement based approaches. This thesis proposes graph theoretical and real-time approaches to estimate the capacities of individual links in a multi-hop ad hoc network and uses analytical modeling to derive node throughputs and successful transmission probabilities of individual nodes in multi-hop ad hoc networks.*

## **1. Introduction**

The capacity and performance studies of multi-hop networks in the literature is as follows. Yang et al obtained expressions for throughput of a semi-saturated and unsaturated network. But they did not consider in the model the hidden terminal problem, which is an important aspect of multi-hop networks[1]. Chhaya and Gupta analyzed the effect of capture and hidden nodes. Li and Blake studied the capacities of multi-hop networks for standard topologies and random traffic pattern. The analysis however is for the entire network and not on a per link basis[2]. Liaw et al proposed a method to estimate the throughput available to a node based on local measurements and neighbor information and channel occupancy of the node. However the approach is traffic dependent[3].

Jain et al analyzed the impact of interference on multi-hop networks using a linear programming framework. They gave a framework for getting upper and lower bounds for flow throughput. Similarly Kodialam and Nandagopal characterized the achievable rates for single and multiple flows. In both the above approaches, the computation of feasible single or multiple flows assumes the knowledge of link capacity or a link's bit rate[4]. Samrath et al , Li et al and Kazantzidis et al in their work used the channel access time of a station's current traffic to predict the achievable bandwidth of flows. With new flows getting added, the competition for the channel intensifies among the flows and the old channel access time measured doesn't reflect the bandwidth allocation for the new flows[5].

The efficiency of the IEEE 802.11 protocol directly affects the utilization of the channel capacity and system performance. Performance evaluation of single-hop ad hoc networks using IEEE 802.11 MAC is done in Bianchi , Carvalho and Aceves , Li et al , and Liwa et al In the case of multi-hop ad hoc networks using DCF protocol, performance analysis needs consideration of many factors. Much work has gone into studying the interaction between higher layers and IEEE 802.11 MAC in multi-hop networks[6]. Xu and Saadawi brought out the problems in fairness and throughput variations when TCP is used with 802.11 MAC. Fairness issues and enhancement of MAC are studied by Tang and Gerla and Bensaou et al[7] . Eladly and Chen extended the saturation throughput model of Bianchi to the case of multiple overlapping BSSs. However a comprehensive analysis of performance of the IEEE 802.11 based multi-hop networks is still an ongoing research work. Wang and Aceves analyzed the performance of CSMA/CA based multi-hop networks using different Markov models for channel and node. Yawen and Biaz combined the Bianchi model to get a three dimensional model to analyze the performance of a multi-hop network under different traffic loads and network densities[8].

## 2. Models

In this section, we highlight the models such as simulation model, traffic and mobility model.

### 2.1 Simulation Model

A detailed simulation model based on ns-2 is used in the evaluation. In a recent paper the Monarch research group at Carnegie-Mellon University developed support for simulating multihop wireless networks complete with physical, data link, and medium access control (MAC) layer models on ns-2. The Distributed Coordination Function (DCF) of IEEE 802.11 for wireless LANs is used as the MAC layer protocol. An unslotted carrier sense multiple access (CSMA) technique with collision avoidance (CSMA/CA) is used to transmit the data packets. The radio model uses characteristics similar to a commercial radio interface, Lucent's WaveLAN. WaveLAN is modeled as a shared-media radio with a nominal bit rate of 2 Mb/s and a nominal radio range of 250 m.

### 2.2 The Traffic and Mobility Models

Continuous bit rate (CBR) traffic sources are used. The source-destination pairs are spread randomly over the network. Only 512-byte data packets are used. The number of source-destination pairs and the packet sending rate in each pair is varied to change the offered load in the network.

## 3. Dynamic Bandwidth Allocation

This section describes how we introduce the differentiation in the available bandwidth estimation and how we use this estimation for a regulation of Best Effort traffic. The first step is the differentiated estimation of the available bandwidth. It will allow us to quantify the proportion of the available bandwidth which is occupied by Best Effort flows. This estimation relies on the protocol ABE (Section 3). However, in the current state, ABE is not able to differentiate between QoS and Best Effort data packets. Therefore we present hereafter how we perform this differentiation in order to enhance the measurement accuracy.

### 3.1 Differentiation between QoS and Best effort traffic:

As explained previously, a differentiation between QoS and Best Effort flows allows a better use of the available bandwidth for new QoS transmissions. We assume that each packet is marked in its IP header in order to know to which kind of flow it belongs, i.e. a QoS flow or a BE flow. The differentiation in the remaining bandwidth estimation is simply done at the MAC layer and consists in measuring only medium occupancy of QoS data packets during the monitoring phase of ABE. Note that this differentiation is only possible if the node is able to decode data sensed over the medium since packets IP header has to be examined. Packets sent in the carrier sensing area of this node will not be decoded because the signal perceived is below the transmission range threshold. Consequently, in DRBT, the estimation of the available bandwidth is differentiated if the packet sensed over the medium can be decoded. In other words, Best Effort traffic that cannot be decoded are included in the used bandwidth during the monitoring. To summary, each node computes its differentiated remaining bandwidth by removing the bandwidth consumed by QoS flows in its communication range and consumed by all the flows in its carrier sensing area. Then this differentiated remaining bandwidth per node is used to compute the differentiated remaining bandwidth per link with the ABE method.

**3.2 Regulation of Best Effort traffic:**

The previous available bandwidth estimation is not enough to provide guarantees to QoS flows. The BE traffic needs also to be regulated. In DRBT, the regulation scheme concerns only the Best Effort traffic. This regulation is done in two steps:

- Decreasing the throughput of Best Effort flows when a new QoS flow wishes to be transmitted and does not find enough available bandwidth because this one is partially consumed by Best Effort transmissions.
- Increasing the throughput of Best Effort flows when a QoS flow releases its bandwidth or moves to another transmission area.

This regulation is coupled with a routing protocol in order to benefit of signaling packets to disseminate information required for our regulation mechanism. We have slightly modified AODV in order to transform it into a QoS protocol, called DRBT henceforth. The choice of AODV is driven by the possibility to use broadcasted route request messages and route reply messages to inform and regulate BE flows and to find adequate (constrained) routes for QoS flows.

**3.3 Reduction of Best Effort traffic:**

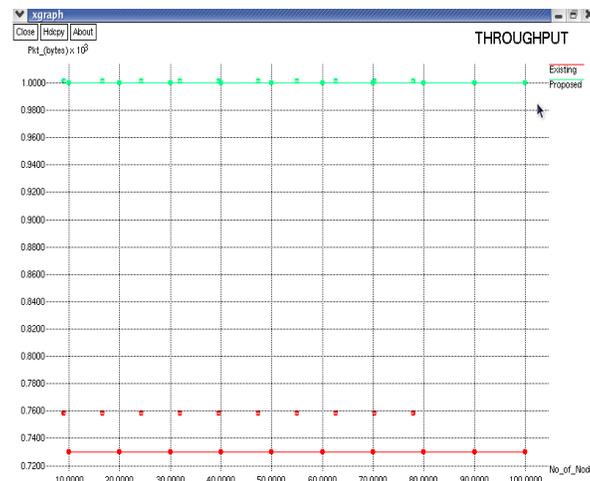
In this section we explain how we decrease the throughput of Best Effort flows. The regulation process of BE flows is triggered when a new QoS flow asks to be accepted in the network. Therefore, the search of an adequate route for a QoS flow is intimately linked to the possible regulation of some BE flows. To do this, DRBT does not introduce additional message overhead but uses classical RREQ (Route Request) and RREP (Route Reply) packets found in AODV. Every time a new QoS flow wants to transmit data, it checks the resources availability using these RREQ and RREP packets. The information stored on these packets with DRBT are:

- The throughput requested by the new QoS flow (ThroughputQoS).
- The number of Best Effort flows (nbBE) within the neighborhood of the path on which the QoS flow is transmitted.

**4. Results**

**4.1 Simulation Result:**

In this phase, the performance data of four routing protocols (AODV and DBA) are collected. A scenario is set up for data collection. This scenario is run 10 times with 10 different values of the mobility ranging from 10 to 100 seconds. In general, the actual values of the performance metrics in a given scenario are affected by many factors, such as node speed, moving direction of the nodes, the destination of the traffic, data flow, congestion at a specific node, etc. It is therefore difficult to evaluate the performance of a protocol by directly comparing the acquired metrics from individual scenarios. In order to obtain representative values for the performance metrics, we decided to take the average values of multiple simulation runs.



**Figure: Simulation Result of Node Vs Throughput**

The Graph Shown in figure comprises the results of Throughput with no of node taking Throughput along Y-axis and mobility along X-axis. This graph shown in Figure indicates the throughput values for different number of nodes. We are comparing the proposed protocol DBA with the Existing protocol AODV.

The throughput outcome is good when compare with all other protocol. We obtained the transmission range of TX Range and the carrier-sensing range by similar approaches. We fixed the information table of each node and set the distance between successive nodes with the help of smart secured route using DBA.

DBA improves throughput in terms of mobility when compared with all other protocols.

## 5. Conclusion

The estimation methods proposed have provided a ground work for all future enhancements in this area. Mac is used to allocate bandwidth. The quality of service is improved through the Dynamic Bandwidth Allocation. The Distributed methods give good enough estimates but with lesser accuracy compared to the former. While the centralized approaches use an NP-hard algorithm for their estimations, the distributed schemes have very less or no complexity. Given the advantage of real-time estimations, the lesser accuracy of distributed schemes is acceptable. Considering that the model approximates the back off process, the accuracy of the results are reasonably good.

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