An Enhanced Scheduling Algorithm for Qos Optimization in 802.11e Based Networks

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Abstract

Quality of Service (QoS) is the ability to guarantee a certain level of performance to a data flow ie., guaranteeing required bit rate, delay, etc. IEEE 802.11 a/b/g networks do not provide QoS differentiation among multimedia traffic. QoS provisioning is one of the essential features in IEEE 802.11e. It uses Enhanced Distributed Channel Access (EDCA) which is a contention-based channel access mode to provide QoS differentiation. EDCA works with four Access Categories (AC). Differentiation of Access Categories are achieved by differentiating the Arbitration Inter-Frame Space (AIFS), the initial contention window size (CWmin), the maximum contention window size (CWmax) and the transmission opportunity (TXOP). However AIFS, CWmin, CWmax are considered to be fixed for a given AC, while TXOP may be varied. A TXOP is a time period when a station has the right to initiate transmissions onto the wireless medium. By varying the TXOP value among the ACs the QoS optimization-throughput stability and minimum delay is achieved. EDCA has many advantages such as it fully utilizes the channel bandwidth, and does not require centralized admission control and scheduling algorithms over the contention-free access mode.

Index terms— EDCA, MAC, IEEE 802.11e, Quality of Service, QoS optimization

The 802.11e MAC supports the access categories which are listed in Table **??**.

Table **??** Access categories T Fig. **??** QoS optimization process e) Qos Optimization Fig. **??** describes the process of QoS optimization. Initially heterogeneous traffic reaches the MAC and they are mapped to the corresponding Access Categories. Then all frequency-related parameters of various Access Categories are fixed, by controlling the TXOP Limit parameter the higher priority traffic has a higher chance of being sent and waits a little less before it sends its packet, on average, than a station with low priority traffic. In this paper we propose a new optimization algorithm which is the modification of EDCA and that new algorithm provides per stream QoS which is not available in EDCA [2] and it is achieved by tuning the duration of transmission opportunity parameter called TXOP limit.

This new work follows the implementation details outlined by, Khaled A. Shuaib. The author specified the cell structure of wireless networks, important parameters needed for creating the simula used in Qualnet simulation tool [5].

1 e) TXOP LIMIT-The Controlling Knob

Consider S wireless stations compete for the shared air medium of a wireless LAN using the IEEE 802.11e EDCA protocol. These wireless stations transmit data to/from the base station at different bit rates, and the rate differentiation is achieved by varying the TXOP limits for individual wireless stations. In optimization problem, it is a need to determine the total effective airtime (EA) of the wireless medium so that it can be divided among stations, and to avoid over/under allocation of the wireless medium. The virtual transmission time v j as the time duration between the jth and the (j + 1)-th successful transmissions is defined.

2 Each virtual transmission consists of three periods: Idle Collision Transmission

Let consider E[x] to denote the average transmission opportunity limit for all wireless stations, and E[v] to denote the average virtual transmission time.

Then, the effective airtime can be given by:EA = E[x]/E[v]

(2) Let denote the number of collisions in a virtual transmission time by C, define i k to be the duration of the k-th idle period, and similarly, c k to be the duration of the k-th collision period. Then E[v] is given by:E[v] = E[C](E[c] + t d + t s + t a) + (E[C] + 1) E[i] + E[x] + t d (3)

Where, t d is the distributed inter-frame space (DIFS), t s is the short inter-frame space (SIFS), t a is the average time of sending an acknowledgment.

From the equation (3) it is found that optimal solution for airtime differentiation comes from controlling Average end-to-end delay is calculated at the Access Point using the following formula.

Fig. **??** Average End-to-End delay analysis Fig. **??** shows the average end-to-end delay of the Access Point. From the statistics (.stat) file of created scenario, it is clear that the delay of high priority traffic is comparatively less than the low priority traffic.

The QoS optimization is provided by Enhanced Distributed Channel Access mode in IEEE 802.11e based Networks. With EDCA, packets are categorized into prioritized classes, higher priority traffic has a higher chance of being sent and waits a little less before it sends its packet, on average, than a station with low priority traffic. Using EDCA the quality improvement comes at negligible cost, because the optimal solution is computed using simple equations. EDCA is suited for networks which support link-layer traffic differentiation.

In future, the EDCA mechanism can be implemented for IEEE 802.16 based networks and the cross layering framework can also be included to improve the QoS optimization. [1]

Figure 1: An

1

Figure 2: Fig. 1

Figure 3:

ITRODUCTION

Figure 4:

N

Figure 5:

6

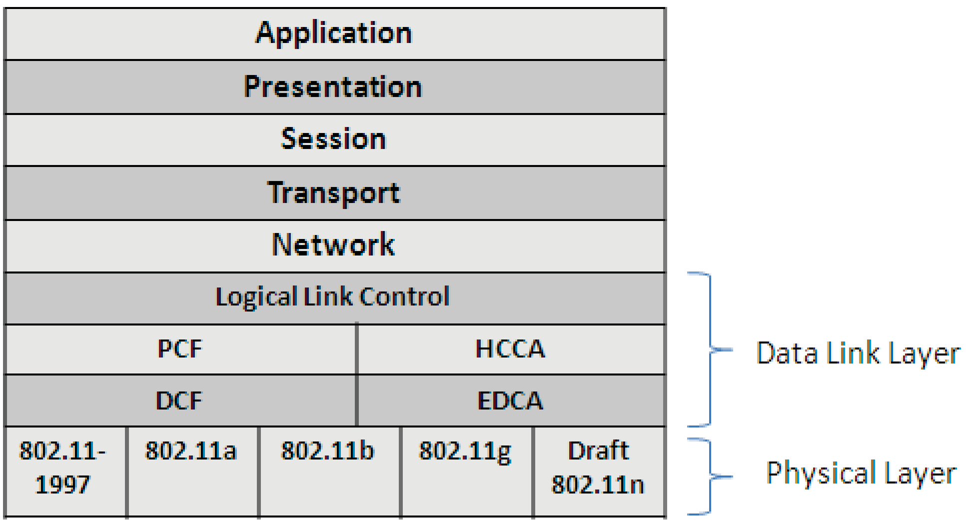

Figure 6: Fig. 6

7 II.

Figure 7: Fig. 7

[11e; Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications; Amendment: Medium Access Contr *11e; Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications; Amendment: Medium Access Control (MAC) QoS Enhancements*, 802 p. . (IEEE Std)

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