Modified MAC for Priority Traffic with Slow Decrease of Contention Window and Reservation based Packet Forwarding in IEEE 802.11 for QoS Provisioning

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Abstract

IEEE 802.11 lacks of the capability to support Quality of Services such as multimedia and real-time traffic properly. This paper presents a simple approach to enhance the multimedia real-time performance over the 802.11 WLAN by implementing a Quality of Service Manager (QoSM) for differentiating services with two queues on top of the 802.11 Medium Access controller. With slow decrease of contention window (SD) and reservation based packet forwarding. The proposed scheme is verified with the help of ns-2 and an improved performance for multimedia real-time service in the infrastructure-based WLAN with the coexistence of the non-real time traffic.

1. Introduction

IEEE 802.11 WLAN has gained the prevailing position in the market for the (indoor) broadband wireless access networking. WLAN defines the functionality of medium access control (MAC) layer and physical (PHY) layer specifications for WLAN [2]. The mandatory part of the MAC is the distributed coordinated function (DCF) [2] [8]. DCF supports best-effort service without guaranteeing any QoS and having no service differentiation [1] [2] [6] [7]. A wireless multimedia LAN approach has described in [3] [4]. A DCF with shortened CW for QoS support is described in [8].

In this paper we consider a software upgrade-based deployment approach to provide a limited QoS for real-time multimedia service enhancement over MAC controller of the 802.11 WLAN. This scheme implements a QoSM, as per [9] with Q_q and BE_q on top of the 802.11 MAC controller. Basically, the Q_p and BE_p packets are classified and assigned into one of the two queues. Then after a strict priority policy is used to forward the packets from two queues in order to give a priority to quality (real-time multimedia) packets from Q_q, the BE_q queue is never served as long as the Q_q is non-empty.

The rest of the paper is organized as follows. Section 2, describes QoSM with slow decrease of contention window and reservation based packet forwarding. Simulation study is described in section 3 by using ns-2. We conclude in section 4.

2. Quality of Service Management Strategy (QoSM)

The QoSM strategy including the algorithms (QoSM and QEM) and performance measure is taken from [9]

2.1. Slow Contention Window Decrease (SD)

DCF follows a binary exponential backoff (BEB) within the contention range (CW_{min} to CW_{max}) [12]. As in [12] slow contention window decrease scheme is described for legacy DCF, which achieves a high throughput. This slow contention window decrease (SD) is applied in the presence of QoSM is defined as:

$CW \longleftarrow \max(\delta * CW_{old}, CW_{max})$ upon success

Where $\delta = 0.5$

2.2. Reservation Based Packet Forwarding (RPF)

The mechanism strict forwarding is modified to a reservation based, i.e. forwarding of packet with period restriction for QoS. Period restriction implies that Q_q is allowed to be transmitted only for the specified duration of Period I. And Period II allows transmitting both of the Q_q and BE_q. Period I and II constitutes a super period. Super period is taken to be 1msec, and two periods are divided into two equal halves.

3. Simulation Analysis

Performance analysis of legacy MAC and QoSM a modified MAC is done with the help of ns-2 [5]. The scheme is tested for real time multimedia data stream. We have use 802.11b PHY for simulation that can handle data up to 11 Mbits/s [2]. Two different types of traffic are used, multimedia and FTP/TCP data. Where queues are drop tailed and can accommodate 50 packets. The network topology and parameters for simulation is taken from [9]. Also follows the same for both MM station and data station as described in Section V of [9].

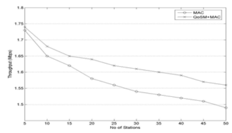


Figure 1. Throughput Analysis

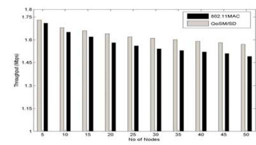
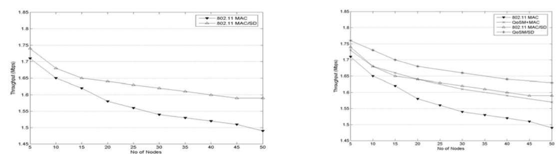


Figure 2. Throughput of the system with RPF



(a) (b)

Figure 3. (a) Throughput of 802.11 MAC with SD (b) Throughput of 802.11 MAC, QoSM, 802.11 MAC with SD and QoSM with SD for real time traffic.

The throughput achieved for QoSM is better in comparison to legacy MAC with DCF for real-time multimedia data. Figure 1 describes the throughput analysis is described between QoSM +MAC and legacy MAC. The throughput is increased by using QoSM scheme as compared to legacy MAC for only real-time multimedia data. The δ value is taken as 0.5. Figure 3 (a) 802.11 MAC with SD achieves a better throughput in compare to legacy MAC. So SD of contention window decrease scheme shows a better performance. Figure 3 (b) shows that QoSM with SD gives much better throughput in compared to 802.11 MAC, 802.11 MAC with SD and QoSM for real time traffic. Figure 2 shows the overall throughput of the QoSM/SD with RPF achieves better throughput in compared to legacy 802.11, in presence of both real time and best effort traffic.

4. Conclusion

We proposed a modified MAC scheme based on queueing with RPF. The proposed scheme may be deployed for real-time multimedia traffic on the top of the MAC controller. To demonstrate the performance of real-time multimedia data can be enhanced significantly through the QoSM with SD scheme when real-time multimedia traffic and QoSM with SD and RPF gives a better throughput than legacy 802.11 MAC in presence of both type of traffic real time and best effort traffic. This scheme requires further enhancement to support voice traffic.

5. References

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