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Quality of Service (Qos) Enhancement for Multimedia Applications using Sorter with Earliest Expiry Time (Sweet) Technique

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ABSTRACT
Mobile Multimedia applications have experienced an explosive growth nowadays.People are more excited to receive high speed videos in addition to audio,voice and web services even when they are on move.However, multimedia applications require certain Quality of Service (QoS) support such as guaranteed bandwidth,delay and jitter.Although IEEE 802.11 Wireless LAN (WLAN) is most widely used WLAN standard today, it cannot provide QoS support for increasing number of multimedia applications. Thus, 802.11e provides QoS to multimedia applications.In this paper, a Priority Technique based on EET (Earliest Expiry Time) in SWEET(Sorter With Earliest Expiry Time) module is proposed in IEEE 802.11 for rescheduling and servicing of video packets with desired QoS. The simulation results produced a better performance when compared with existing one.

Keywords
IEEE 802.11, Medium Access Control (MAC), Quality of Service (QoS), Distributed Coordination Function (DCF), Point Coordination Function (PCF),SWEET module, EET.

1. INTRODUCTION
IEEE 802.11 wireless LAN (WLAN) is one of the most deployed wireless technologies and is likely to play a major role in next-generation wireless communication networks [1]. The main characteristics of the 802.11 WLAN technology are simplicity, flexibility and cost effectiveness. This technology provides users with a ubiquitous communication and computing environment in offices, hospitals, campuses, factories, airports, stock markets, etc. Guaranteeing QoS requirements in 802.11 WLAN is very challenging due to the QoS unaware functions of its medium access control (MAC) layer,noisy and variable physical(PHY)layer characteristics. In this paper we mainly focus on QoS issues in 802.11 MAC layer.
The primary objectives of this paper are to:

- Introduce an overview of IEEE 802.11 WLAN standard.
- Survey the main QoS enhancement schemes that have been proposed for 802.11 WLAN.

2. OVERVIEW OF IEEE 802.11 WLAN
IEEE 802.11 defines two different architectures, BSS (Basic Service Set) and IBSS(Independent Basic Service Set) comprising of number of wireless stations called STAs, associated to an AP (Access Point). All communications take place through the AP. In an Independent Basic Service Set, STAs can communicate directly to each other, providing that they are within each other's transmission range. This form of architecture is facilitated to form a wireless ad-hoc network in absence of any network infrastructure as in [4],[5]. Several BSS can be connected together via a Distribution System (DS) to form an extended network, called Extended Service Set (ESS). Figure 1 illustrates the architecture of IEEE 802.11 BSS.

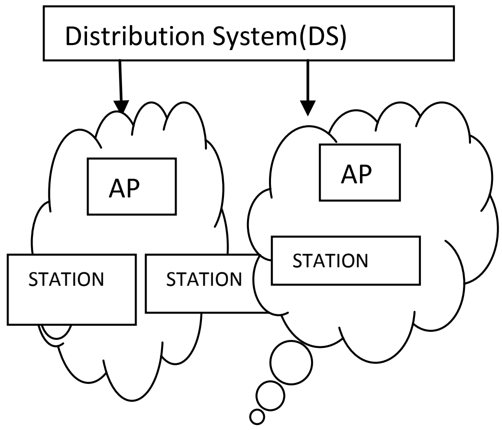


Figure 1: Architecture of IEEE 802.11

2.1 IEEE 802.11 MAC:
IEEE802.11 MAC provides two channel access controls, DCF (Distributed Coordination Function) and PCF (Point Coordination Function) [3]. DCF is based on CSMA/CA (Carrier-sense Multiple Access with Collision Avoidance) and PCF provides contention-free channel access but is supported only in infrastructure networks[4].

In DCF, the sender sends a DATA frame to the receiver when it determines that the medium is idle for greater than or equal to DIFS period. On the receipt of the DATA frame, the receiver replies with an ACK (Acknowledgement) frame after SIFS period expires. If other STAs receiving the DATA frame, they set NAV (Network Allocation Vector) value using duration field in the header in the DATA frame and cannot access the medium during that time. Using NAV to prohibit others from accessing the medium is called Virtual Carrier

Sense.

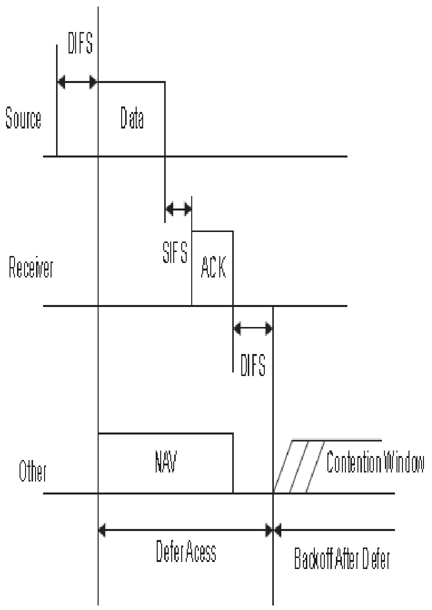


Figure 2: DCF mechanism (from ref[1])

If a STA has transmitted a DATA frame and does not receive the corresponding ACK frame ,it can retransmit the DATA frame until retransmission limit is reached. Before retransmission, it performs backoff which is randomly selected as depicted in Equation 1,

Backoff Time = Random(0,CW) **(1)**

where CW is the current contention window whose size is increased every time when transmission fail decreasing the collision probability.

Point Coordination Function (PCF) is a centralized, polling-based access mechanism [5] in which time is divided into superframes consists of a contention period when DCF is used and a contention-free period (CFP) when PCF is used. The CFP is started by a beacon frame sent by the base station, using the ordinary DCF access method. Therefore, the CFP may be shortened since the base station has to contend for the medium. During the CFP, the PC polls each station in its polling list (the high priority stations), when they are clear to access the medium. To ensure that no PCF data frames(PIFS) is shorter than the usual IFS (DIFS) and to prevent starvation of stations that are not allowed to send during the CFP, there must always be at least one maximum length frame to be sent during the contention period.

If the CFP terminates before all stations have been polled, the polling list will be resumed at the next station in the CFP cycle. In case of an unsuccessful transmission the station may retransmit the frame after being repolled or during the next Contention Period.

3 QoS LIMITATIONS OF IEEE 802.11

DCF can only support best-effort services without any QoS guarantees. Typically, time-bounded services such as Voice over IP, audio/video conferencing require certain QoS such as specified bandwidth, delay and jitter, which are not supported by DCF since all the STAs in one BSS compete for the resources and channel with the same priorities. Although PCF has been designed to support time-bounded multimedia applications, this mode has three main problems such as inefficient channel resources, unpredictable beacon delays and difficulty in control of the transmission time of a polled STA that lead to poor QoS performances[5][11] [10,11,12].

4 PROPOSED PRIORITY TECHNIQUES

In this technique, real and non-real time applications such as voice,video, filetransfer and web service are given as ascending order priority respectively.

Real and Non-real time applications requested by the users are voice, video, file transfer and web traffic. Particularly, the video application is scheduled by the SWEET (Sorter With Earliest Expiry Time) module.This module according to user's request calculate the Earliest ExpiryTime (EET) to create fairness.

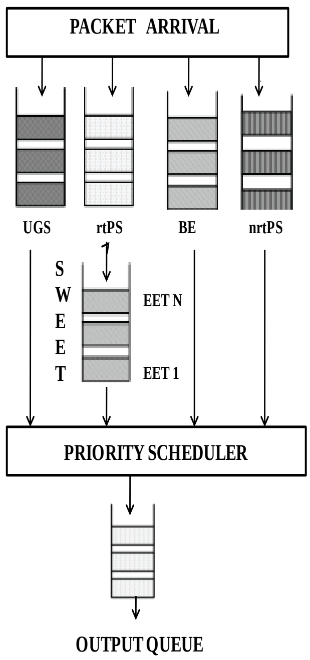


Figure 3: Scheduler Architecture

IEEE 802.11e popularly provides QoS, unlike IEEE 802.11 with the addition of EDCA. In this proposed technique, QoS for MAC is enhanced by the rescheduling of video packets using the SWEET (Sorter With Earliest Expiry Time) module.

The various applications are then transmitted to the priority scheduler. The priority scheduler schedules the various applications on the basis of the type of applications and organized in the queue and then transmitted. This architecture increases the throughput for the number of users.

The sources of traffic used in the simulation are voice, video, Web, and file transfer, which were mapped,respectively, by the service classes as UGS, rtPS, BE, and nrtPS. The voice traffic was modeled by means of an on/off source. During the "on" periods, packets of 66bytes were generated every 20ms, following the exponential distribution as assumed in the paper[6]. The video traffic was modeled by a traffic source that generates, regularly, packets in different sizes, simulating the MPEG traffic. The web traffic was modeled by a hybrid Lognormal/Pareto distribution. The body of the distribution corresponding to an area of 0.88 was modeled as a Lognormal distribution with mean of 7,247 bytes, and the tail was modeled as a Pareto distribution with a mean of 10,558 bytes. The file transfer traffic was generated using a source with exponential distribution and average packets size of 512kb [6][10,11,12].

4.1Earliest Expiry Time (EET)

The rtPS scheduler guarantees the limited maximum delay for the rtPS service through the use of a new EET-based scheme. The scheduler assigns a EET for each rtPS connection. Equation 2 is used to calculate the ithEET value.

$EETi=TTi+PDi \;\; ,\forall i| \; \mathbf{Mi}$ **(2)**

Where **TTi** is the transmission time calculated for each rtPS connection.The TTi parameter is calculated in accordance with the expression (3):

$$TT_{i} = \frac{BWrequest\_size \times 8 \;\; *symbol\ time}{bpsymbol} \quad \mathbf{(3)}$$

Where BW_request_size is the amount of bytes requested by the stations(SSs) for uplink transmission, bpsymbol is the amount of bits/symbol used in the transmission. This former parameter is dependent on the modulation and coding used and symbol_time is the OFDM or OFDMA symbol duration time.

PDi: Polling delay corresponds to the interval time when the bandwidth is requested and when it is allocated[7]. This parameter is dependent on the number of rtPS connections. When there are few rtPS connections at the network, the polling delay is low but, when the number of rtPS connections increases, the polling delay also increases, being considered in the EET calculation.Once calculated the EET, the proposed algorithm organizes the rtPS connections by the lowest EET. Thus, the scheduler defines the transmission order of the rtPS connections. GloMoSim is used as network simulation software.

5. GLOMOSIM

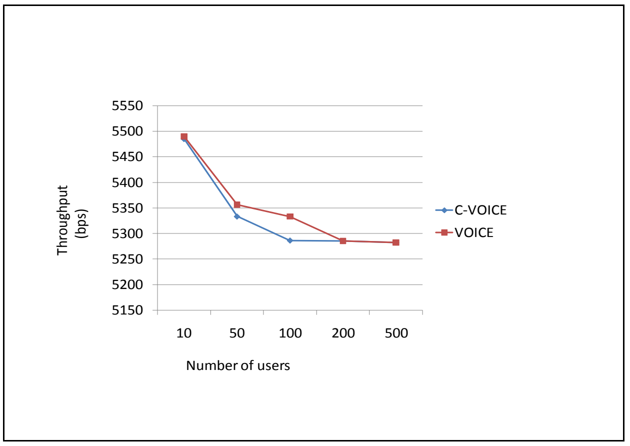
GloMoSim is the Global Mobile Information Systems Simulation Library.This is specially oriented to simulate wireless and ad-hoc networks[8]. GloMoSim uses parallel discrete-event simulation capability provided by PARSEC.Execution of a single discrete event simulation program on a parallelcomputer to facilitate quick execution of large simulation programs[17],[21],[22].

5.1 Simulation Results

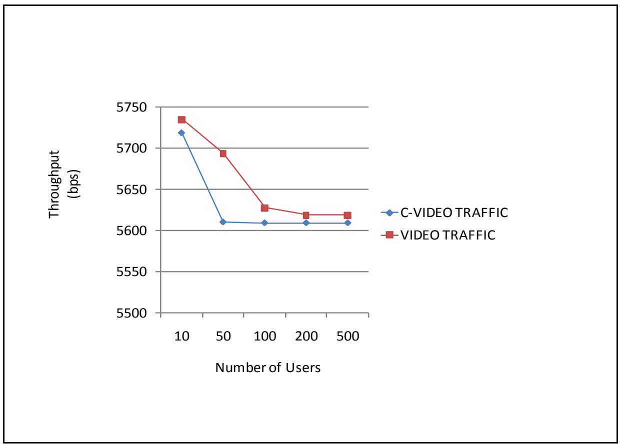
Experiments are carried out under different scenarios to plot the graph between the number of users and the throughput and delay[9]. By varying the number of users, throughput and delay are measured.The graph shows the comparison of the prioritized and non-prioritized applications.

Experiment 1: Number Of Users Vs Throughput For Voice Traffic

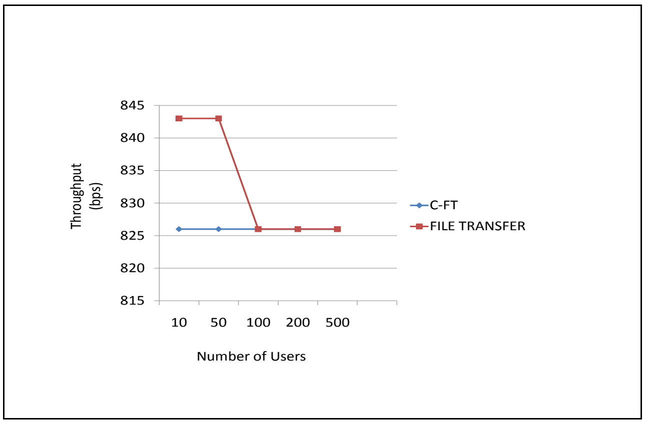
The simulation results shows improvement in attained throughput by using proposed technique over conventional method. In the graph 'c' shows conventional method results.



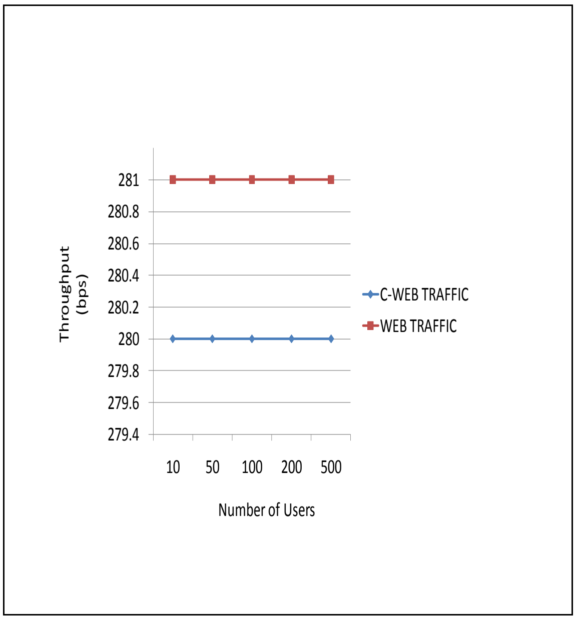
Experiment 2: NUMBER OF Usersvs THROUGHPUT FOR VIDEO TRAFFIC



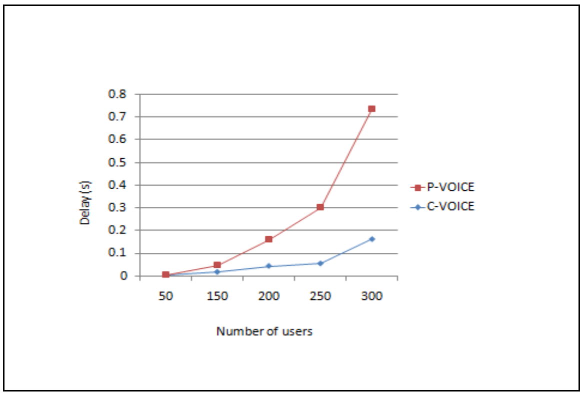
Experiment 3:Number Of Users Vsthroughput For File Transfer



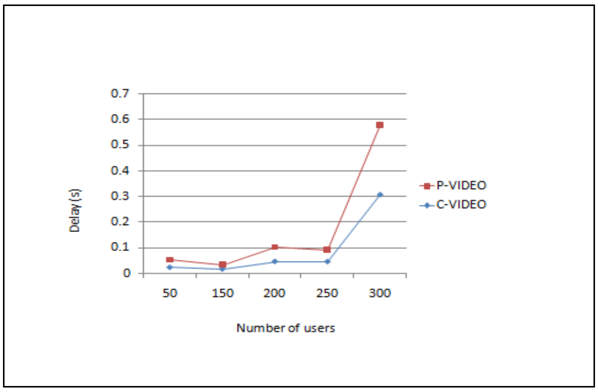
Experiment4: Numberof Users Vs Throughput For Web Traffic



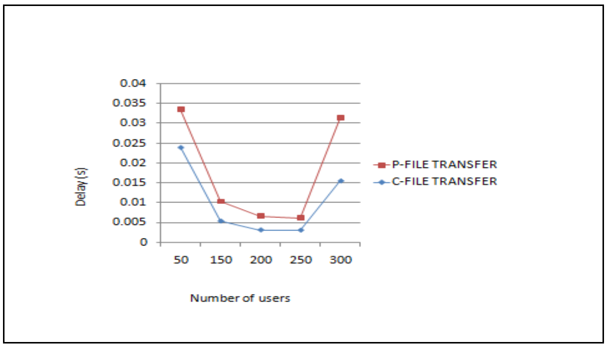
Experiment5: Number Of Users Vs Delay For Voice



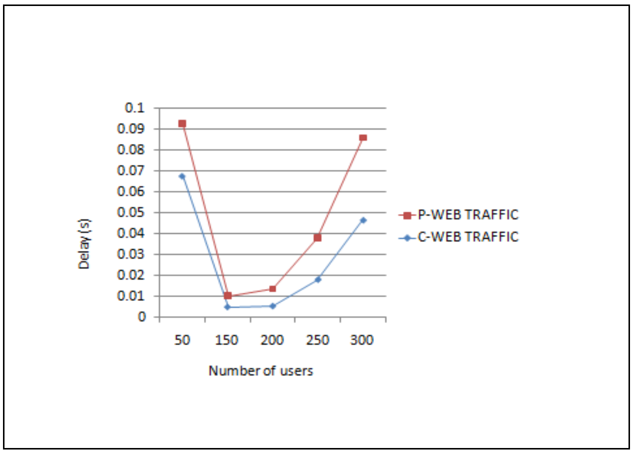
Experiment 6: Number Of Users Vs Delay For Video Traffic



Experiment 7: Number Of Users Vs Delay For File Transfer



Experiment 8: Number Of Users Vs Delay For Web Traffic



6. CONCLUSION

This paper has presented the performance evaluation of the IEEE 802.11with respect to QoS enhancement. The simulation result shows that the throughput and delay of the prioritized applications has improved when compared to non-prioritized applications.Thus, by rescheduling the multimedia applications as per their EET- earliest expiry time in SWEET module, substantial improvement in QoS parameters such as throughput and delay could be implemented in IEEE 802.11.

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