Performance Analysis of Wireless Distributed Networks by Prioritizing Delay Sensitive Traffics

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Abstract— In this 21st Century the usage of Wireless Distributed Systems is increasing day by day in all major application fields it may be WLANs, WMANs, Bluetooth or WSN's. Here in wireless distributed systems a Medium Access Control (MAC) protocol which is generally used to provide defined limited range of communication bandwidth. Most of the bandwidth required in network is basically dependent on type of traffic exchanged over a channel. In general, Best-Effort traffic is transmitted in all networks and the major problem with such networks is they do not support Quality of Service (QoS) for time critical (Real Time) applications. Since most of real-time applications are delay sensitive and time critical, So in this paper we are considering various real time interactive traffics such as, Background, Best Effort, Voice and Video further we are prioritizing these traffics and analyzing the performance with different scenarios.

Key words: WLANs, QoS, Prioritize, CW, DCF, PCF, EDCA

I. Introduction

Wireless Local Area Networks (WLANs) and Wireless Sensor Networks (WSNs) are the most popular existing wireless distributed technology all over the world because of its low implementation cost, easy deployment, simplicity and its robustness against failures. These advantages are a result of its distributed approach of Medium Access Control (MAC) protocol. Currently, the popularity of real-time interactive and multimedia applications is growing rapidly day by day. So its been a challenge to provide assured QoS for subscribers/users in the networks.

In Wireless distributed systems, the MAC sub-layer defines basically two medium access coordination functions: namely

1) Distributed Coordination Function (DCF) and
2) Point Coordination Function (PCF).

DCF is the basic access function for wireless (IEEE 802.11) and is based on a Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) algorithm together with a contention based (back-off) algorithm [1].

PCF uses a centralized polling method which requires a Node to act as the role of Point Coordinator (PC). Where this PC cyclically polls the stations to give them the opportunity to transmit.

But both DCF and PCF networks are actually based on Best-Effort networks and they do not support Quality of Service. To overcome this, In year 2005, a EDCA has been introduced to replace the best effort services in order to guarantee QoS attributes[1]. This standard focuses on replacing the conventional Distributed Coordination Function (DCF) and the optional Point Coordination Function (PCF) of the Medium Access Control (MAC) layer by a Hybrid Coordination Function (HCF) [2].

The HCF defines two medium access mechanisms:

1) Contention-based channel access also known as Enhanced Distributed Channel Access (EDCA), and
2) Controlled channel access also known as HCF Controlled Channel Access (HCCA).

In this paper we focus on implementing the EDCA techinique. The EDCA is a Contention Window (CW) based channel access function which is based on assigning priority for different kinds of delay sensitive/ time critical traffics to guarantee the minimum bandwidth needed, i.e., if higher the priority then lesser the contention period, which holds good for time critical applications and thus improving the network performance. If no priority is assigned then congestion of traffic and network load reduces the performance of network usage and results in bad performance and poor QoS whenever the demand for medium utilization increases [2] [3].

II. QoS Support mechanism

Most of the applications require the network to provide higher quality levels of services for better performance. Hence Quality of service (QoS) is widely used to provide the best possible effort of adding varying levels of priority to any given delay sensitive traffic. The use of background, voice, video and other very delay-sensitive applications are driving this requirement into the Wireless Distributed Systems.

QoS on any networks enables enhanced and reliable network services in several ways, including major of the following:

- Dedicated reserved bandwidth for various critical users and delay sensitive applications.
- Limiting a jitter and latency (required by real-time delay sensitive traffic).
- Minimizing overall network load/ congestion.
- Shaping a network traffic to smooth the traffic flow.

– Setting up network for various traffic priorities.

III. ENHANCED DISTRIBUTED CHANNEL ACCES (EDCA)

EDCA is used to provide prioritized QoS, EDCA enhances the original DCF by introducing user priorities (UP) and access categories (AC). Whenever delay sensitive traffic arrives to the MAC layer it has a user priority value that is mapped into an access category (AC) as in Table.1. shows the mapping specified in the described amendment. The highest AC is the voice category and lowest is the background category.

Table.1: EDCA user priorities to access categories mappings

	User Priority	Access Category (AC)	Designation
Lowest	1	0	Background
↓	2	0	Background
	0	1	Best Effort
	3	1	Best Effort
	4	2	Video
	5	2	Video
	6	3	Voice
Highest	7	3	Voice

EDCA, medium access is contention-based using the same back-off algorithm as DCF and is prioritized by three configurable parameters: the contention window size (CW), the arbitration inter frame space (AIFS) and the transmission opportunity limit (TXOP).

CW and AIFS are used to determine the probability of gaining the channel access, while TXOP determines the time of occupying the channel after the channel access is obtained.

Here the station has to back-off its amount of time before every transmission attempt is made. AIFS defines the total amount of time that has to be sensed idle before the backoff procedure is initialized/resumed. Flows of different priorities are assigned different parameter values to increase/decrease their chance of gaining medium access.

Generally, traffic with higher priority has the smaller CW and/or AIFS values. On the other hand, the TXOP limit enables the block acknowledgment following a normal successful DATA-ACK transmission. It determines the time of occupying the channel after the access is obtained.

IV. RESULTS AND DISCUSSIONS

In our scenario we have taken pair of Background, Best Effort, Voice and Video nodes to exchange all the traffic in between as shown in fig.1. Here all nodes transmit data to Centralized Access Point (QAP) so the data aggregation will be much easier, in this scenario each and every nodes are assigned with above EDCA priority AC values. The scenario is simulated for variable CBR traffic ranging from 100.Kbps to 1000.Kbps and fixed packet size of 256.Bytes.

A. Proposed Scenario:

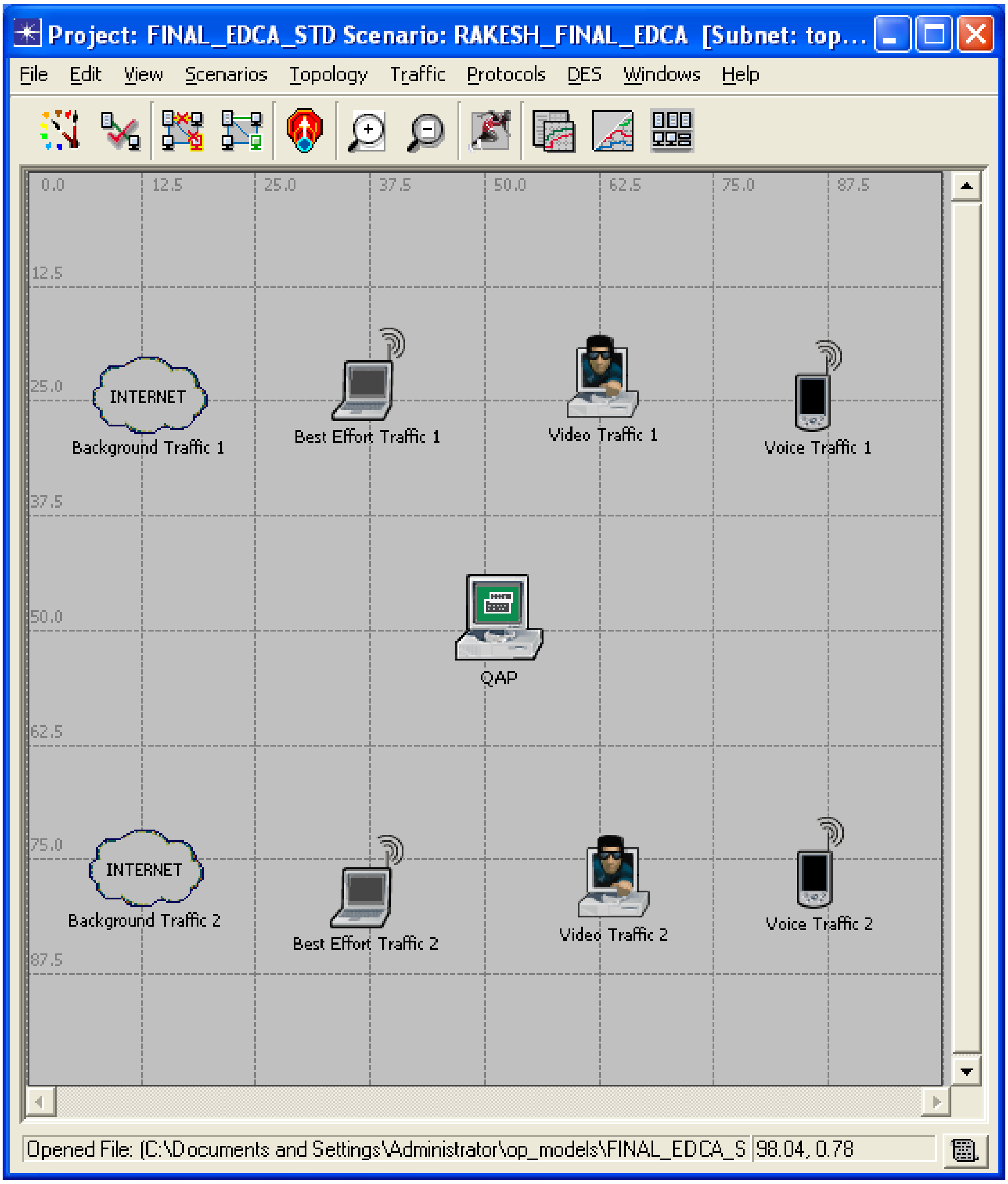

Fig. 1: Proposed Scenario With EDCA parameters

Dimension of Topography	100*100
Packet Size	256 Bytes
CBR Traffic	100.Kbps to 1000.Kbps
Priority Method	EDCA

Table 2: Simulation Parameters

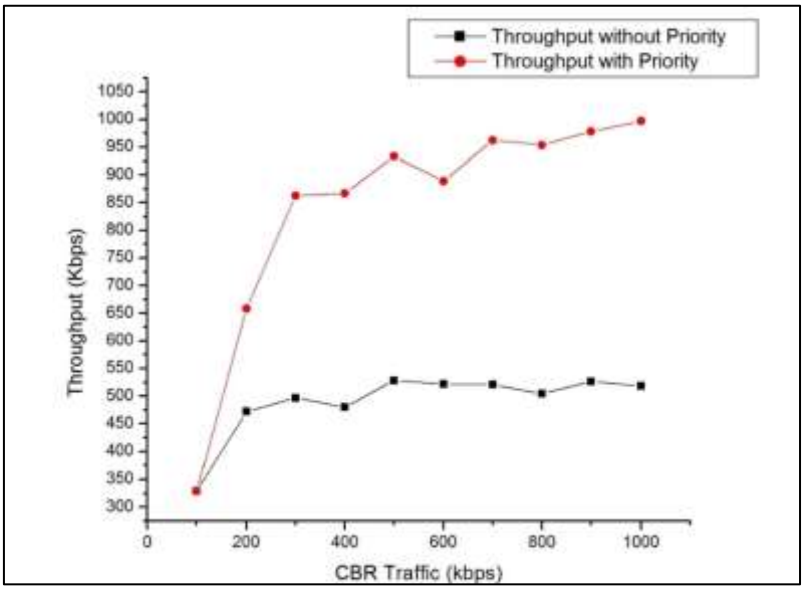

Fig. 2: Throughput performance of EDCA over DCF

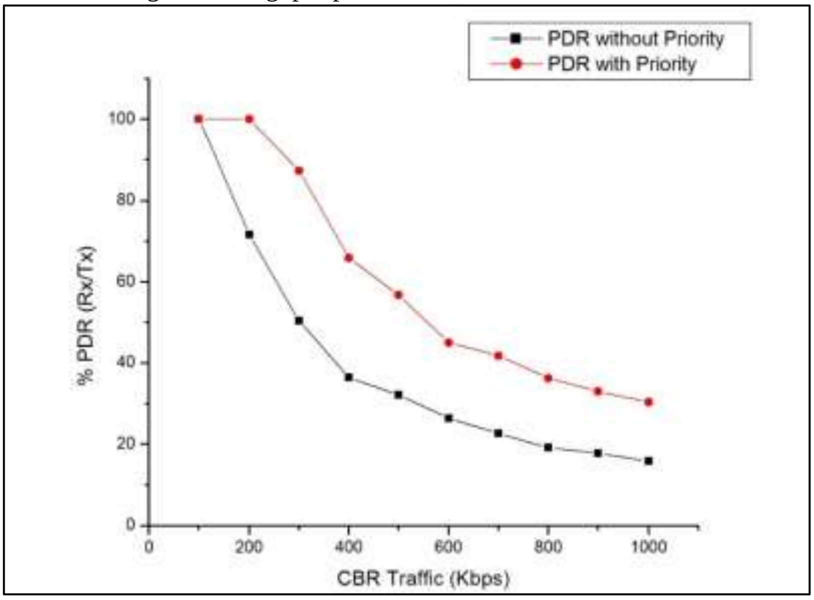

Fig. 3: Packet Delivery Ratio of EDCA over DCF

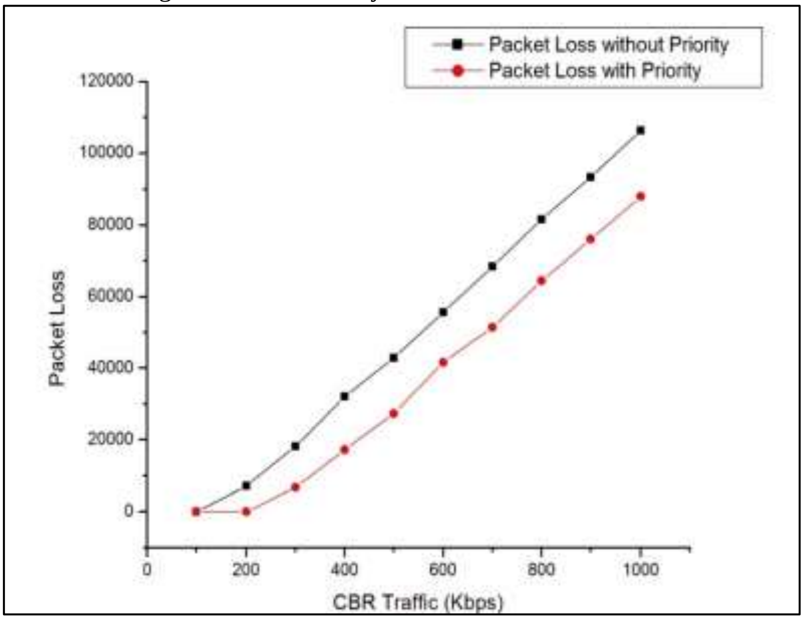

Fig. 4: Packet Loss of EDCA over DCF

Our simulated results are more impressive and we can clearly see that prioritizing delay sensitive traffic by use of EDCA surpass the overall performance compared with traditional non prioritized DCF function. By analysing the performance parameters, we can clearly state that the overall Throughput and Packet Delivery Ratio of EDCA has been doubled by applying priority to delay sensitive traffic whereas Packet loss has been minimized upto 30% as shown in fig.2, fig.3 and fig.4.

V. CONCLUSION

Our obtained results excel and outperform over non prioritized DCF method, by prioritizing traffics the overall Throughput and Packet Delivery Ratio of EDCA has been doubled, whereas the Packet loss has been minimized upto 30%. By this performance analysis we can clearly say that the prioritizing traffic will helps us to improve networks congestion/load problems, minimizes delay by providing min Contention period and maximum TXOP, overall energy consumption will be minimum so this method can be preferred to be used in WSNs and Medical Applications.

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