MULTIPLE QUALITY OF SERVICE USING 802.11e FOR WLANs:

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1- Application programming

2- Computer programming

"In the name of Almighty Allah (SWT) WHO is most merciful and beneficial"

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

It is He Who taught the Quran, He has created the human, He has taught him speech (and intelligence),the sun and the Moon Follow courses (exactly) computed and the herbs and the trees both prostrate in adoration, then which of the favors of your lord will ye deny

Al-Rahman (chap: 55)

Final Approval

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It is certified that the thesis titled **"Multiple Quality of Service using 802.11e for WLANs"** submitted by **Ambreen Memon**, Registration No. **598-FBAS/MSCS/F09**, has been reviewed and approved as per standard thesis requirement. The undersigned hereby confirms that this certificate of approval serves as a confirmation, that the thesis has been successfully completed. The thesis including abstract is approved for the award of MS Degree in Computer Science by International Islamic University, Islamabad.

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DEDICATION

I dedicate this project to my beloved Holy Prophet Hazrat Muhammad (SAW) "The Mohsin" of whole humanity, my parents, my respected teachers and all my well wishers. who have supported me all the way since the beginning of my studies. Without their knowledge, wisdom and guidance, I would have not the goals that I have strive and be the best to reach my dream.

DISSERTATION

A dissertation is submitted to the

Department of Computer Science

International Islamic University Islamabad

As a partial fulfillment of the requirement

For the award of the degree of

MS (CS) in Computer Science

DECLARATION

I hereby declare that this software "multiple quality of services using 802.11e using WLANs" is neither, as a whole nor, as a part thereof has been copied out from any source. It is further declare that I have developed this software and accompanied report entirely on the basis of my personal effort made under the sincere guidance of my kind supervisor 'Dr Muhammad Sher' I shall stand by the consequences. No portion of the work presented in this report' has been submitted in the support of any application for any other degree or qualification of this or any other university or institute of learning.

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In the end, I am thankful to all fellows who have helped me in completing this degree.

Ambreen Memon

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THESIS IN BRIEF

Project Titled	Multiple Quality of Service using 802.11e for WLANs:
Objective	To strict the QoS
Undertaken by	Ambreen Memon
Supervised by	Dr. Muhammad Sher - Chairman, Department of Computer Science & Software Engineering. International University Islamabad
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Tools & Technologies	Opnet Modular
Platform used	Window XP
System Used	Pentium iv

LIST OF ABBREVIATION

(EDCA)	Enhance Distributed Coordination Function
(VOIP)	Voice over Internet Protocol
(SLA)	Service Level Agreement
(IETF)	Internet Engineering Task Force
(ITU-T)	International Telecommunication Union
(INTServ)	Integrated Services
(DiffServ)	Differentiated Services
(CW)	Contention Window
(DCF)	Distributed Coordination Function
(PCF)	Point Coordination Function
(MAC)	Medium Access Control
(HCCA)	HCF Controlled Channel Access
(AC)	Admission Control
(BA)	Block acknowledgement
(DA)	Design science
(ACELP)	Algebraic Code Excited Linear Prediction
(Ata)	Analog Terminal Adopter
(CSMA/CD)	Carrier Sense Multiple Access With Collision Dedication

LIST OF ABBREVIATION

(CODEC)	Compression /Decompression
(GUI)	Graphic User Interface
(GK)	Gate Keeper
(GW)	Gateway
(IP)	Internet Protocol
(ITU)	International Telecommunication Union
(LAN)	Local Area Network
(MAC)	Medium Access Control
(MCU)	Multipoint Control Unit
(PBX)	Private Branch Exchange
(PCM)	Pulse Code Modulation
(POTS)	Plain Old Telephone System
(PSTN)	Public Switched Telephone Network
(QoS)	Quality of Services
(RTCP)	Real Time Control Protocol
(SOHO)	Small Office and Home Office
(SIP)	Session Initiation Protocol

ABSTRACT

This work improves the quality of service(QoS) into multiple quality service(mQoS) initially the QoS is the set of technologies for managing network traffic in a cost effective manner to enhance user experiences for home and enterprise environments. QoS technologies allow you to measure bandwidth, detect changing network conditions (such as congestion or availability of bandwidth), and prioritize traffic. For example, QoS technologies can be applied to prioritize traffic for latency-sensitive applications (such as voice or video) and to control the impact of latency-insensitive traffic (such as bulk data transfers). When in mQoS many existing applications demand the immediate use of several communication channels with different Quality of Service (QoS) requirements. For optimal performance, the application designer should be able to specify a protocol stack that meets her / his QoS requirements through the composition of micro-protocol.

The IEEE 802.11e working group has worked hard and develop a new standard called IEEE 802.11e to support QoS in WLANs. The IEEE 802.11e defines a mechanism to support QoS for real time multimedia applications, such as Voice over Internet Protocol (VoIP) and Video Conferencing. However, recent studies have shown that the IEEE 802.11e (EDCA) neither perform well under medium-to-high traffic loads nor supports strict QoS. (i.e emergency support is not inherent in EDCA).

Providing strict QoS support to emergency users in WLANs is an important issue especially in congestion situation (New Year's Day, tsunami, earthquake, fire or any other large scale natural disaster when network load increase number of times).

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CHAPTER # 1

INTRODUCTION

Wireless local area network (WLANs) is now widely used for emergency purposes because of its support to real time multimedia applications and fast deployment capability. Real time multimedia traffic for emergency not only characterised by their high bandwidth requirements, but also impose severe strict restrictions on packet delay (response time), jitter (delay variance) and packet losses. In other worlds, multimedia applications for emergency require a strict Quality of Service(QoS).

Providing strict QoS support to time sensitive traffic in WLANs is a issue of paramount especially in congestion situation (New Year's Day, tsunami, earthquake, fire or any other disaster when network load increase number of times). The IEEE 802.11e working group develop a new standard called 802.11e to support QoS in WLANs. However, recent studies have shown that the IEEE 802.11e neither perform well under medium-to-high traffic loads nor supports strict QoS.

A study of QoS aware protocols has been done. A very limited work has been done in the support of Emergency Traffic (strict QoS). Therefore, it is strongly required to develop a mechanism for the strict QoS to support emergency traffic in congestion situation. We propose Emergency Enabled Enhanced Distributed Channel Access (EE-EDCA) for the 802.11e framework to address the Emergency Traffic in WLANs, where emergency traffic gets the privileges to the other traffic in congestion or emergency situation.

1. The Main Initiatives

The aim of this research is to develop a new strict QoS aware MAC protocols (using cross-layer approach) for strict real time multimedia applications (e.g. emergency traffic, voice) over WLANs. An exhaustive comparative analysis will be carried out using various methods such as Markov chains, Queuing theory, Probabilistic analysis, meta-modelling, L-square distance methods, complexity theory. The strict QoS modelling will be carried out using a network modelling and simulation tools namely Opnet Modeler.

1.1. Quality of Service (QoS)

This is a standard topic of the telecommunications. It is not be enough to complete in one part. Yet a broad topic is protocol layers, QoS routing protocols, , bandwidth, resource management, queuing methods, signaling service level agreement (SLA), policies and QoS capable medium access control (MAC layer).

QoS is perceived and interpreted by different communities in a different way. Technical or Network communities refer QoS as the measure of service quality provided by network to the users. Internet Engineering Task Force (IETF) defines QoS as "a set of service requirements to be met by the network while transporting a flow" (RFC 2386). The main goal is to provide QoS services while maximizing network resource utilization. The application/users community refer QoS as the quality perceived by application/users. International Telecommunication Union (ITU-T) defines QoS as follows: "the ability of a network or network portion to provide the functions related to communications between users". From this perspective, the users are not concerned that how the network is managing its resources to provide the QoS support.

De-facto the notion of QoS was from the user perspective. In the course of time, the dominating research perspective on QoS has become more and more technical one, focusing on monitoring and improving network performance parameters like packet loss, delay, jitter, and etc, as described in Table 1.1.

Table 1.1. Key Parameters of Network Performance

Parameters	**Description**
Delay (Latency)	Essential time to transfer packet across a network
Capacity (Throughput)	The quantity of data that can be moved per unit of time
Variability (Jitter)	The duration that occur during delay of multiple packets.
Packet Loss	Router or end devices will drop packets when buffer capacity is full.

Add QoS support in packet switched networks use two primary approaches Differentiated Services (DiffServ) and Integrated Services (IntServ).

IntServ use parameterized approach. In this model, applications reserve resources through a network. It provides individualized QoS guarantees to individual application session in the internet. IntServ provides fine grained service guarantees to individual flows. It requires a module in every hop IP router along the path that reserves resources for each session. However, IntServ is not deployed since its requirement of setting state in all routers along a path is not scalable

DiffServ also use prioritized approach. This model wants to give the services, in which services have some differentiation that can handle different classes of traffic in different ways. DiffServ provides a model offering coarse grained QoS by classifying traffic into other classes as they need, also described in class of Service, and relate QoS parameters to those classes. To complete this, packets are first divided into classes by marking the IP header using the Type of Services byte in the IP header. In answer to these markings, switches and routers use a variety of queuing policies to modify performance to requirements. Table 1.2: summarized both QoS approaches.

Table 1.2. QoS Approaches Used In Modern Packet Switched IP Networks.

QoS Model	**Features**	**Traffic Engineer Approach**
Integrated Service (IntServ)	Network resources are allocated according to an application's QoS call and subject matter to bandwidth management policy	Parameterized Approach (Fine-Grain)
Differentiated Service (DiffServ)	QoS is achieved via some strategies as Traffic classes, Traffic Priorities, Queuing mechanism, Policy Management and admission control, policy	Prioritized Approach (Coarse-Grain)

1.2.1.IEEE 802.11 In Wireless Local Area Networks (WLAN)

The IEEE 802.11 Wireless LANs have gained widespread popularity and become ubiquitous in Wireless Local Area Networks (WLANs) owing to their attractive properties, such as fast deployment capability, low-cost, well defined international standard (e.g. 802.11a/b/g), flexibility and mobility offered by the technology. There are several 802.11 standards [give reference of standards] for wireless LAN technology, including 802.11a, 802.11b, and 802.11g. Table 1.3 summarizes the main characteristics of these standards. They all use the same carrier sense multiple access with collision avoidance (CSMA/CA) protocol,. All use the same frame structure for their link-layer frames as well. All these standards have the ability to reduce their transmission rate in order to reach out over greater distances And all three standards allow for both "infrastructure mode and ad hoc mode",

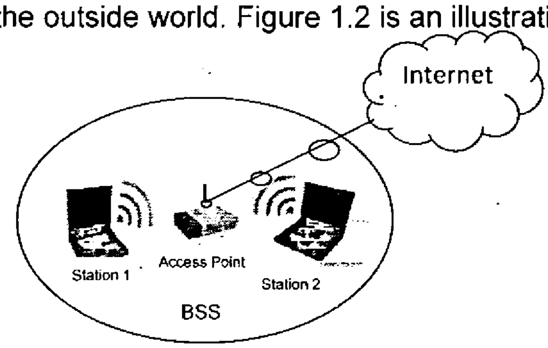
Table 1.3. IEEE Standards

Standards of 802.11	Introduce	Frequency (GHz)	Data Rate Per Steam (Mbit/s)	acceptable MIMO Stream	Module	Bandwidth (MHz)	Interior Range (me)	Outdoor Range (me)
802.11	1997 June	2.4	1, 2	1	DSSS, FSSS	20	20	100
802.11 a	1999 Sep.	5, 3.7	6, 9, 12, 18, 24, 36, 48, 54	1	OFDM	20	35	120
802.11 b	1999 Sep.	2.4	5.5, 11	1	DSSS	20	38	140
802.11 g	2003 June	2.4	6, 9, 12, 18, 24, 36, 48, 54	1	DSS OFDM	20	38	140
802.11 n	2009 Oct	2.4, 5	7.2 - 150	4	OFDM	40	70	250

1.2.2. The 802.11 Architecture

The basic service set (BSS) is the basic block structure of the 802.11 architecture. A BSS contain more then one wireless stations and a central point base station knows as an access point (AP) in 802.11 parlances. Wireless LANs that deploy APs are often referred to as infrastructure wireless LANs, with the infrastructure being the APs along with the wired Ethernet infrastructure that interconnects the APs and a router as illustrated in figure 1.1.

IEEE 802.11 stations can also group themselves together to form an ad-hoc network for the purpose of internet worked communications without the aid of an infrastructure network. Network without central control and with no connections to the outside world. Figure 1.2 is an illustration of an independent BSS (IBSS).



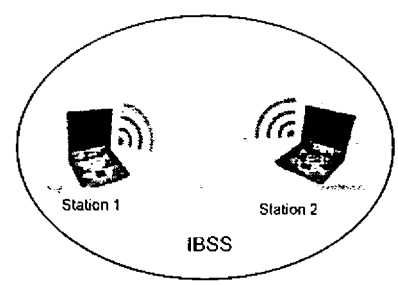


Figure 1.1. An IEEE 802.11 Infrastructure Network

Figure 1.2. An IEEE 802.11 ad-hoc network

1.2.3 The 802.11 (MAC) Protocol

The 802.11 MAC layer protocol is one of the most important component of WLAN. The 802.11 MAC uses the distributed coordination function (DCF) as a core. DCF is contention based protocol can provide best-effort service. The main advantage of DCF is that it promotes fairness among stations. DCF is built on the CSMA/CA medium and optional request to send and clear to send (RTS/CTS) mechanism to share the medium between multiple stations. In CSMA/CA, STA must sense the medium before initiating a packet. 802.11 refer two types of carrier sensing: PHY carrier sensing at air interface and virtual carrier sensing at the MAC layer. PHY carrier sensing detects the presence of all other 802.11 WLAN STAs by analyzing all detected packets, and detects activity in the channel via relative signal strength from other sources. Virtual carrier sensing can be used by source STA to inform about how long the channel will be reserved for its frame transmission to all other STAs within same BSSS. For this purpose source STA can set duration field in MAC header of data frame, or RTS and CTS control frame. Then, all other STAs can update their local timers of network allocation vectors (NAV), which indicate the duration (amount of time in micro seconds).

Three IFS intervals are specified in the standard: short IFS (SIFS), point coordination fnction IFS (PIFS), and DCF-IFS (DIFS). The SIFS interval is the smallest IFS, followed by PIFS and DIFS, respectively.

All STA waits until the channel becomes idle for a DIFS period which is calculated from DCF parameters, DCF parameters are defined in Table 1.4, and than backoff process starts. In the process, Each STA chooses a random interval, called backoff timer computed from CW: random[0, CW] x SlotTime, where CWmin < CW < CWmax (values of CWmin, CW, CWmax and slotTime based on PHY layer). All STAs decrement their backoff timer until the medium becomes busy. If the time has not reached zero and the medium becomes busy, the STA freezes its timer. When the timer is finally decremented to zero, the STA transmit its frame. If two or more STAs decrement to zero at the same time, a collision will occur. On successful transmission, receiving STA transmit ACK packet after SIFS. If ACK packet is not received then sender assumes that transmitted frame was collided and than sender

STA retransmits the frame. To reduce the probability of collision CW is doubled till the CWmax.

Backoff -Timer = Random[0, CW] x SlotTime;

where CWmin < CW < CWmax;

DIFS = 1 x SIFS + (2 X Slot Time)

Table 1.4. IEEE 802.11 Standards in Default DCF Parameter.

Standard IEEE 802.11	**SIFS**	**SlotTime μs**	**DIFS**	**CW(max)**	**CW(min)**
802.11a	16μs	9μsμs	34μs	1023	15
802.11b	10μs	20μs	50μs	1023	31
802.11g	10μs	Short= 9 μs Long= 20μs	Short= 8ps Long= 50μs	1023	Short = 15 Long = 31
802.11n	16μs	9μs	34	1023	15

Note: For backwards compatibility 802.11g and 802.11n use short lot times in the presence of legacy 802.11b STA(s) and use long slot time when no legacy STAs are present while operating in the 2.4 GHz spectrum.

The 802.11 MAC defines another coordination function called point coordination function (PCF). The PCF is an optional capability that is connection oriented and provides contention free (CF) frame transfer. This is available on in infrastructure mode, where stations are connected to the network through an Access Point. PCF is used to transmit time sensitive frames. PCF uses centralized polling method based on the round robin algorithm. PCF implementation could be very complicated. Due to its complexity, it was only implemented by very few numbers of vendors. [14]

1.2.4 QoS and WMM for IEEE 802.11e

The IEEE 802.11 has introduced a new standard called IEEE 802.11e for WLANs by extending the real legacy IEEE 802.11 to grip the QoS for real time multimedia applications, like as Video on Demand (VoD), Voice over Internet Protocol (VoIP), IPTV and some other time sensitive application. IEEE 802.11e established a new coordination function called hybrid coordination function(HCF). The HCF has merged with the DCF and PCF with some improved, QoS specific mechanisms. HCF consists on a controlled channel access, referred to as the HCF controlled channel access (HCCA) mechanism and on contention based channel access method, called (EDCA) enhanced distributed channel access mechanism for contention based. Both EDCA and HCCA works on top of DCF.

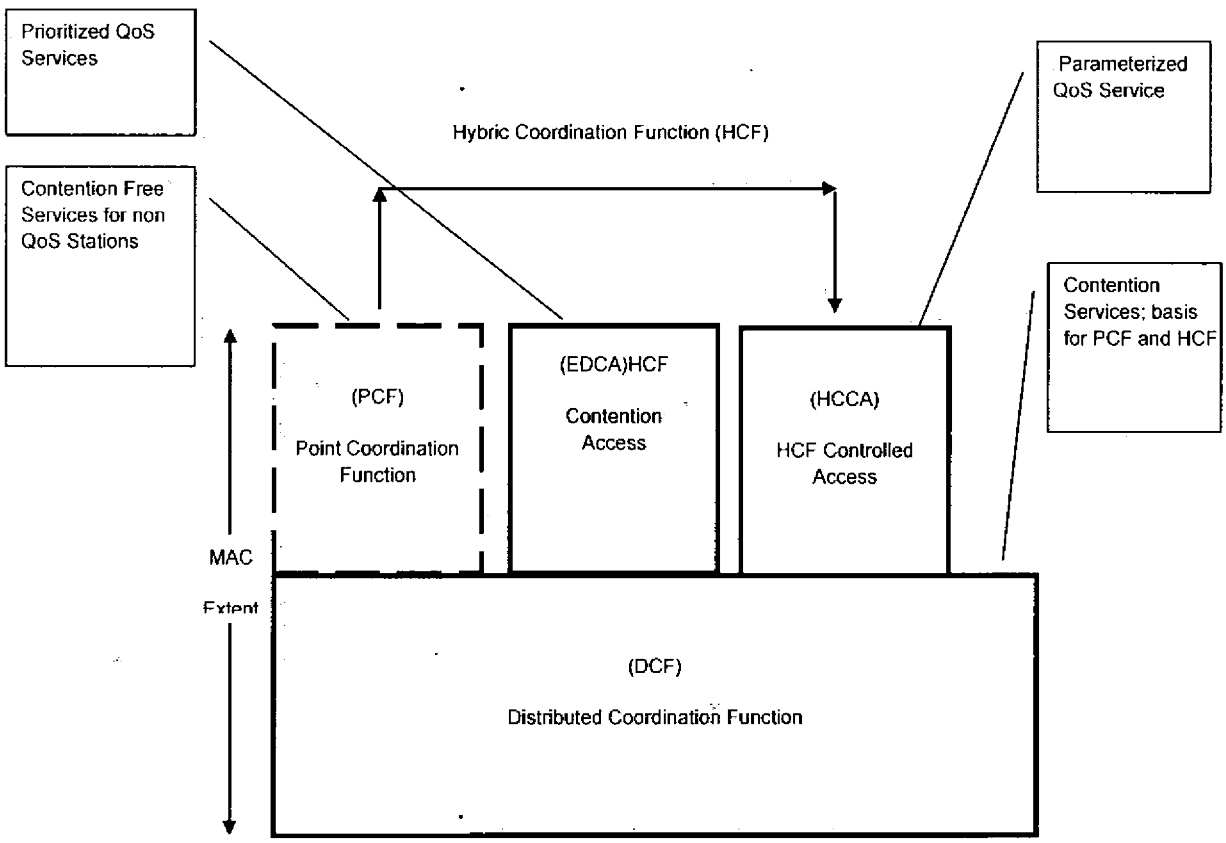


Figure 1.3: IEEE 802.11e MAC architecture [22]

1.3 Enhanced Distributed Channel Access (EDCA)

The Enhanced Distributed Channel Access (EDCA), also recognized as HCF contention based channel access, apply prioritized QoS approach. The EDCA describes the access category (AC) mechanism that works to gives the priorities at the each station. Even satiation is divided into four categories to support the user priorities (UPs) which defined in IEEE 802.1D. ACs priorities are defined in Table 1.5.

Table 1.5. User Priority to Access Category

Priority	**User Priority**	**(AC)Access Category**	**802.1D Description**	**Designation (Information)**
Lowest	1	AC_BK	Background	Background
↓	2	AC_BK	Not defined	Background
	0	AC_BE	Best effort	Best Effort
	3	AC_BE	Excellent effort	Best Effort
	4	AC_VI	Control load	Video
	5	AC_VI	Voice	Video
	6	AC_VO	Video	Voice
Highest	7	AC_VO	Network Control	Voice

EDCA delivers the traffic on differentiation UPs. This differentiation is achieved through the EDCA parameters: Contention Window (CW), Arbitration Interframe Space (AIFS), and Transmit Opportunity (TxOp). EDCA parameters are defined in Table1.6.

Table 1.6. EDCA Parameter

Parameters	AC	CWmax	CWmin	AIFS	TXOP Limit	
					FHSS	DSSS
DCF	-	aCWmax	aCW	2	0	0
EDCA	AC_BK	aCWmax	aCWmin	7	0	0
	AC_BE	aCWmax	aCWmin	3	0	0
	AC_VI	aCWmin	(aCWmin + 1)/2 - 1	2	6.016ms	3.008ms

An AC with higher priority is assigned a shorter CW in order to ensure that higher priority AC will be able to transmit before lower priority ones. This is done by setting the CW limits: CWmin[AC] and CWmax[AC], from which CW[AC] is computed, to different values for different ACs. CW is determined by:

CW[AC] = CWmin <= CWmax

For further differentiation, different inter-frame space (IFS) is introduced according to ACs. Instead of DIFS, an arbitration IFS (AIFS) is used. The AIFS is at least DIFS, and can be enlarged individually for each AC. Similar to DCF, if the medium is sensed to be idle in the EDCA mechanism, a transmission can begin immediately. Otherwise, the station defers until the end of current transmission on the Wireless Medium (WM). After deferral, the station waits for a period of AIFS

[AC] to start a backoff procedure. The backoff interval is now a random number drawn from the interval (1, CW[AC] + 1). Each AC within station contends for access to the WM and independently starts its backoff time after sensing the medium is idle for at least AIFS.

$$AIFS\ [AC] = AIFSN\ [AC] \times Slot\ Time + SIFS \quad (1)$$

Clash between ACs for a single station are resolved by contributing the medium to highest priority AC and lower priority AC will bakeoff.

The priority to voice or video applications IEEE 802.11e initiated (TXOP) transmission opportunity. TXOP is an space of time while a particular QoS station (QSTA) has ability to start the frame restoring the sequences onto the wireless medium (WM). Initialized time for highest duration achieved by TXOP. TXOP is as well achieved by the QSTA by efficiently demanding for the channel and other hand allotted by the(HC) hybrid coordinator. The TXOP edge length values are announced by QA: A TXOP edge values of 0 signified that single Mac Service Data Unit (MSDU) can only be send by STA

1.3.1 Development and Service Differentiation of EDCA

A lot of researchers or scholars estimate the performance of IEEE 802.11e. They have detailed that this perform unsuccessfully because of the high collision rate, or some numbers of slots are going free and MAC/PHY overhead.

Numbers of the research scholars have planned back-off priority strategies (CW), IFS priority schemes or Hybrid scheme to recover the performance of EDCA in medium-to-high traffic load. [12, 13].

Fast collision resolution FCR scheme [14], proposed by Kwon et al which enlarge contention window size for all stations and decrease the back-off in contention resolution phase. FCR scheme allocates least window size and inactive back-off timer to the station having effectively transmitted the packet to keep the inactive time slots. in addition It reduce the back-time timer exponentially as evaluate to linearly as specific in EDCA when a station perceives some idle slots. Authors [14] added future improvement in FCR into real time-FCR scheme to recover the equality and QoS Quality of services hold for time sensitive applications. also proposed similar scheme, In [15] Romdhani et al.namely (A-EDCF) Adaptive EDCF. They identify that the major cause of possibility of collision is rearranging in CW from CW [AC] to CW [min] later than booming transmission in the presence on number of stations challenging the channel. Bearing in mind this reality, author's proposed one by one decrement in CW [AC] by is factor 0.8. factor price will be hold on the collision rate skills by admission control AC. (EDCA-LA) EDCA with link adaption proposed by Lai et al. [16] . Tune back-off timer for each access groups supported on channel conditions.

Few researchers Jian-Xin [17] proposed random adaptive method for adjust MAC parameters (RAMPS) that give different values to same priority flows at any given time. dynamically set combine CW and AIFS to reduce the collision rate and progress in the throughput .detailed a mathematically model for EDCA that consists values CWmin, CWmax, back-off timer, and AIFS.by Kosek-Szott et al [18]

Some other different approaches used by authors [7]; planned QHDC protocol to improve the performance of EDCA. Two modes are use in QHDC: contention mode and active mode. Data use by active mode; broadcasting station will select the next transmitting station from achieve stations standard on possibility class having high priority. EDCA mechanism flow by content mode.

Several researchers' scholars joined CW with back-off timer. Yen Lin and Wu [12] introduce new version of EDCF to recover the performance of EDCA by rising the size of CW on the basis of average clashes rate and select other back-off time.

time evaluation behavior of EDCA while handling real time traffic, by Moraes et al. [19] scholar introduce tuning of CW dependent on channel situation. Another hand Shagdar et al. [20] also introduced throughput with service separation by altering CW of each and every AC and attractive channel busyness ration and number of nodes into account.

A lot of researchers examined (TXOP) Transmit Opportunity to achieve to improve the performance of EDCA.

Kue et al. [21] examined HCCA stander of frame combined mechanism for make best use of throughput for the best efforts traffic even as sustaining the QoS.

1.3.2 Supporting Distributed Emergency Traffic in Wireless Networks

GPRS and GSM, or any other infrastructure networks are highly affected by disasters.For example: During Enscheda fireworks disaster in May, 2000 at Enscheda, Netherlands, a large part of the city destroyed by fireworks exploded. And within few minutes the GSM network became unusable. In London, during Metro incident the authorities considered to turn off the GSM network because bombs exploded via GSM in Madrid. so, ad ad-hoc networking approach will allow the relief groups to enter the disaster area and communicate with each other quickly.

Emergency traffic should be.able to access the channel on highest priority basis, should be capable to access the channel by breaking on- going low priority transmission. It can be implemented by channel pre-emption

Many research scholars have proposed channel pre-emption schemes. Eiager et al. [29] invented LASO pre-emption channel scheme that curtail the on-going transmission duration of lower traffic class, but if channel is assign for pre-allocated time duration then it cannot be interrupted.

In [30] authors proposed Centralized Channel Pre-emption technique which can be only coordinated by a central controller but not suitable for adhoc networks.

Conte et al. [31] investigated central controller admission control of 802.11e to enable emergency call. While using admission control mechanism, additional information is provided to identify and differentiate the requests related to emergency call.

Lu-min et al. [32] evaluated the performance of EDCA while considering emergency traffic during congestion situation; authors proposed a new AC for emergency or any other time critical traffic.

Balakrishnan et al. [33] proposed channel pre-emption EDCA (CP-EDCA) scheme that provide full MAC support to emergency traffic in ad-hoc based distributed networks. Emergency traffic stream can break ongoing session and get the channel access by adjusting SIFS and SlotTime. This scheme is not suitable for dense networks.

Preemption schemes are also proposed in other wireless networks. In [34] investigated channel pre-emption scheme for wireless sensor networks. Scheme claims 50% decrease in delay accessing the medium in emergency. Zhou et al. [35] have defined control emergency channel pre-emption scheme for cellular networks. Authors proposed two queues: one for emergency and one for public; emergency traffic has limited pre-emption capability.

CHAPTER # 2

LITERATURE REVIEW

Since last 10 years, many network researchers have introduced a variety of QoS enhancing based on EDCA parameters. Main contribution is mentioned in the below table 2.1. In this researcher's have designed the QoS aware MAC protocols under active work focused on a particular aspect of QoS needs.

Table 2.1. Contribution on Contention Window

Researchers	Main Involvement	Duration	Description
B. A. Hirantha Sithira Abeysekera et al [1]	Dynamic contention Window	2009	Developed dynamic contention window control Scheme in 802.11e WLANs
C. N. Ojeda-Guerra and I. Alonso-Gonzalez [2]	Split Contention Window size	2008	Introduce a new method to change the contention window and work on channel conditions.
Gaurav Sharma et al [3]	Contention Window	2008	A easy and exact method for approximating the throughput of the 802.11 DCF. The scheme is based on an accurate analysis of the Markov chain.
Jun Lv et al.[4]	Tuning Contention Window	2008	a new method to change the contention window in 802.11e to guarantee together the inter-AC separation and intra-AC one.
Yuxia Lin and Vincent W.S. Wong[5]	organize Contention Window	2008	AMIMO arrangement at the physical layer and the contention window ranges for dissimilar access groups traffic at the MAC layer are equally optimized.

2 Dynamic Contentions [1]

It developed the 'dynamic contention window control scheme' in 802.11e WLANs to achieve the active equality between uplink and downlink in 802.11 wirelesses LAN in block acknowledgement (B.A).Hirantha [1] proposed a scheme through which the IEEE 802.11 MAC Protocol at access points (APs) modified in order to controls the minimum size of 'contention window' and provides an opportunity for whom to get transmission right by simulation with UDP and TCP flow, and 'contention window' size CWmin dynamically control by APs. The proposed scheme adjusts the percentage flow rate of total packets of downlink and uplink. But it is necessary to work with APs function and also select the layer number 3 and 4 e.g. IP address, transport protocol, port number when APs works with wireless link with same power as wireless terminals has in the IEEE 802.11. APs combined with different download flow so this condition is totally unfairness between uplink and downlink

2.1 Split Contention Window [5]

The main motive of original EDCA the value of parameters of every AC queue (just as contention window limit) are strict and do not take channel wireless condition.

C.N.Ojeda [5] proposed a method to adjust the contention window based on channel condition. This method decreases the channel collision and maintains the delays and throughput . The result effective in ad-hoc as well as in infrastructure wireless network. The author introduced a new adoptive mechanism to adopt the CW to channel condition and maintain the network utilization. It modifies a solution in which it consider the number of transmitted packets in every AC queue and collision will be occur in fixed time.

2.3 Tuning of CW (Contention Window) [4]

In order to guarantee the differentiation in both inter-AC and intra AC, the contention window in 802.11e in adjusted. The goal is to improve the delay, collisions and increasing the throughput in heavy network.

Jan Lv et al [4] anticipated an algorithm which take priority and node density and also mentioned the theoretical throughput analysis, with increasing level of multimedia application just as voice and video. so focusing on 802.11e define the different channel access parameters with different traffic flow in the QoS and it support four prioritize queue for incoming traffic each queue is design for specific AC.

The AC with higher priority is assigned a shorter CW in order to ensure that higher priority AC will be able to transmit before lower priority ones. This is done by setting the CW limits: CWmin[AC] and CWmax[AC], from which CW[AC] is computed, to different values for different ACs. CW is determined by;

$$CW[AC] = CWmin <= CWmin$$

While the EDCF have number of functions to discriminate the DCF, it is not enough as it uses only in multimedia application just as voice and video. And it cannot fully capture the complexity of EDCF. It is not considering the number of transmitted packet in each AC queue

Table 2.2. Block Acknowledgement

Researchers	Main involvement	Duration	Description
Wen-Li Li et al. [16]	Delayed Based (DB-ACK) Acknowledgement	2009	A work of fiction ACK mechanism delay depend on ACK (DB-ACK) is introduced to defend real time ultimedia traffic some other traffic.
Carbral O. et al	Based on Buffer Size BA	2009	Suggest Block Acknowledgement Scheme depend on access strategies' Buffer size and traffic load.

2.4 Block Acknowledgement (BA) [16]

The legacy 802.11 uses Stop and Wait Automatic Repeating reQuest (SW-ARQ) scheme. In this scheme sender transmit a single packet and then waits for the acknowledgement. This involves a lot of overhead due to immediate transmission of ACKs after each receiving packet. In IEEE 802.11e introduced a new optional Selective Repeat – ARQ (SQ-ARQ) scheme also known as block acknowledgement (BlockAck) to reduce the overhead. In this scheme a group of data frames can be transmitted one by one without waiting for Ack with SIFS interval between them. Then a single BlockAck frame sent back to sender to inform it how many packets have been received correctly. There are two BlockAck schemes are used in IEEE 802.11e: delayed and immediate. Delayed BlockAck is useful for applications that can tolerate moderate latency. It is very easy to implement. In this scheme the receiver is allowed to send a normal ACK frame first to acknowledge the BlockAck request. Then the receiver can send back the BlockAck at any other time before BlockAckTimeout. Another side, immediate BlockAck scheme is useful for the application that required high bandwidth and low latency. But this scheme is very difficult for implementation to generate the BlockAck within the SIFS time interval.

Recently IEEE 802.11n enhances this BA scheme and made it compulsory part of all high throughput (HT) devices. All devices that support IEEE 802.11n referred as HT devices. Table 10 list the key researchers' main contribution in the BA scheme of QoS aware MAC protocols. BA contains bitmap size of 64*16 bits. These 16 bits accounts the fragment number of the MSDUs to be acknowledged. Each bit of this bitmap represents the status (success/failure) of a MPDU. Newly 802.11n introduced compressed BA. It is an enhanced version of (BA) defined in 802.11n. In compressed BA, Fragmented MPDUs cannot be transmitted and hence the bitmap size is reduced from 1024 (64*16) bits to 64 (64*1) bits.

Table 2.3. Transmit Opportunity

Researchers	Main involvement	Duration	Description
Abhinav Arora et al [6]	Adaptive Transmit Opportunity	2010	Developed an adaptive TXOP (Transmit Opportunity) allocation based on channel conditions and traffic requirements.
Zhengyong et al [7]	Dynamic Transmit Opportunity	2009	A dynamically tuning transmit opportunity method is proposed which allocate transmit opportunity based on traffic conditions.
Hongli Luo and Mei-Ling Shyu [8]	Optimized Transmit Opportunity	2009	An optimized transmit opportunity scheduling scheme is proposed which allocate transmit opportunity to each wireless station based on the optimization performance index and queue length of the wireless stations.
Geyong Min et al. [9]	Transmit Opportunity for Bursty error channels	2009	Proposed an analytical model for the TXOP scheme in the presence of burst error channels.
Jeng-Ji Huang et al [10]	Flexible Transmit Opportunity	2008	An efficient scheduling scheme is proposed that aims at improving packet delay while maintaining high channel utilization.

2.5 Adaptive Transmit Opportunity [6]

Improve the channel condition and physical transmit rate it was also appropriate for existing scheduling algorithm.

Abhinav Arora at al [6] have developed an adaptive (TXOP) transmit opportunity allocation based on channel condition and traffic requirement in IEEE802.11e.

Whiten discuss on 80211e mechanism that it has HCF hybrid coordination function for QoS and in this mechanism also has simple HCF scheduling which support the QoS requirements. TXOP mention the time in which data can be burst and send to the (STA) station. center of attention TXOP has also HCCA polling mechanism just suppose 802.11e and 802.11g/b these all support 4 or 8 data rate.so it verify the channel condition with respect to their requirements.

In order to give priority to voice or video applications IEEE 802.11E introduced transmission opportunity (TxOP). TxOp is an interval of time when a particular QoS station (QSTA) has the right to initiate frame exchange sequences onto the wireless medium (WM). A TxOp is defined by a starting time and a maximum duration. TXOP is either obtained by the QSTA by successfully contending for the channel or assigned by the hybrid coordinator (HC). The TxOp limit duration values are advertised by QA. A TxOp limit values of 0 indicates that STA can only send single Mac Service Data Unit (MSDU).

This mechanism simply adapt (TXOP) work on the already define intervals, not mention the TXOPmin and TXOPmax

Assigning TXOP, the algorithm of the scheduling always receives the main physical rate not actual rate, so that's way it is not best for channel condition and physical rates.

2.6 Optimized Transmit Opportunity [8]

WLAN widely use to transmit the heterogeneous data so HCF composed contention based (EDCA) and (HCF) but HCF or control channel access (HCCA) only support constant bit rate not support the variable bit rate or multimedia bit rate so Honli luo and Mei-ling shyu [8] proposed optimized transmit opportunity scheduling scheme in which allocate the transmit opportunity of wireless station based on optimized performance index and queue length of the wireless station

This scheme improve the different classes traffic Audio, VBR H.263, CBR MPEG4 ever since the HCCA and EDCA use different queues for the traffic flows, but they only consider the Queue of HCCA with discreet time formula

$$q_{K+1}=Q_k+P_k-D_k$$

802.11e define the QoS features including the prioritization of the data in four categories (1) voice (2)video (3) best efforts (4) background but in this scheme discuss only two categories voice and video when these both are already have Highest priority. The HCCA and EDCA use different queues for the traffic flows, but they only consider the Queue of HCCA with discreet time formula.

2.7 Pre-emptive EDCA [33]

IEEE802.11e was very attractive option for emergency traffic during the distributed network operation so Manikanden and Driss proposed [33] an EDCA scheme in channel service pre-emption methodology. This scheme enhances the EDCA protocol that allow emergency frames to interrupt and replace the channel services of the low priority in the network. It also mention that EDCA allow deterministic (no randomly select the channel) rather then randomly channels selection. This research improves/performs the QoS for emergency traffic during distributed (ad-hoc /wireless network) network operation.

It is also work of 802.11e standards that supports centralize polling scheme HCF Controlled channel access (HCCA). These are highly effective regular delay but they have poor performance in irregular emergency arrivals. It is necessary to use EDCA method in unpredictable emergency arrivals. EDCA is easily scalable and we can easily operate in Ad-hoc mod.

In the channel pre-emption CP-EDCA scheme; after channel acquisition, CP-EDCA fit in the emergency pre-emption during the channel transmission, the CP-EDCA also uses CFB (contention free bursting) mod. It allows contiguous transmission of multiple frames for transmission opportunity (TXOP) duration without further delay. CFB supply the best throughputs and also improvement in capacity-limited wireless networks,

CPEDCA use the delay model in which it predict MAC delay per frame, which is the delay suffered by an application frame for successful one hop channel transmission. This model also allows non_ saturated traffic condition.

The priorities describe with little difference; suppose new emergency frames are transmitted & if the channel is free for EPSIF period which is smaller then (NPSIFS) Multiple node attempts to send the emergency frame simultaneously then CP-EDCA receive both as in-node and inter-node pre-emption

The EDCA does not support emergency (health disaster, Monitoring and any sensitive application.

CP EDCA increases the network load, the Emergency pre-emption are achieved by increasing wait duration of routine transmission which will certainly degrade routine traffic performance.

2.8 Prioritization Scheme for Improving QoS in 802.11e [13]

Enhanced Distributed Coordination Function (EDCF) support on diff-Serve model and EDCF provides multiple classes of traffics with different schemes of prioritizations. But with the emergence of new time-sensitive applications, EDCF has proved to be yet inefficient in some kind of traffic because it could not provide well-differentiated QoS. It provides a prioritization scheme to improve the quality in IEEE802.11e; in this scheme they replace uniform PDF with Gamma PDF and using this they furnishing the QoS.

The legacy 802.11 MAC protocol has number of means of differentiating traffic streams or source. All data flows are treated equally (i.e. same priority to access the medium) in both DCF and PCF mechanisms. This means that no special considerations can be given to traffic on the channel for services with critical requirements in bandwidth, delay, jitter, and packet losses for applications such as voice and video. For example a low-priority bursty traffic can choke out a running video stream and thereby destroy the user's experience.

DCF cannot be distinguished between voice, video and the data frame; even EDCF has proved to be yet inefficient in dealing with new time sensitive application because it could not provide network with well-differentiated QoS. It has not mentioned CW min –ATM, in order to achieve better QoS in 802.11e network.

2.9 Improving the QoS in 802.11e based on Virtual Heap Tree [27]

To improve the inefficient utilization of the channel bandwidth resources especially in highly loaded network; Anbao WANG and HaiLan Pan proposed the VHT (virtual heap tree) CSMA architecture to manage with 802.11e wireless network communication environment. It is based on forcing collision resolution mechanism, which is able to prioritize real time(RT) traffic over timing unrestricted traffic. A heap tree is usually a binary tree in which each child node has smaller value then its parents, the child node is smallest node and parent node is larger node. These type of trees like partially ordered with respect to the nodes at another. They use the heap tree because using the heap easily implements in array and maximum and minimum bandwidth can easily be found.

This research use the VHT –CSMA method is base for obtaining channel access through IEEE 802.11e standard protocol ,that new node first calculate their own priorities and determine the order the access media among the various nodes according to the priority.

This paper mentions that WLAN divide into two types of categories one is infrastructure and other is ad-hoc network without infrastructure (infrastructure network mention AP access point).

This method only control the traffic generated by real time nodes. These type of trees partially ordered with respect to the nodes at another, each node firstly calculate their priorities using the some information, it is long procedure

The CSMA structure is answer mechanism to complete detection to the collision, support to judge data transmission requirements of real-time node, however, the data transmission for other nodes would not be considered. In another words, we don't deal with all of the traffic generated in all nodes

2.10 HCF Controlled Channel Access (HCCA)[28]

The HCF-controlled channel access mechanism uses a QoS-aware centralized coordinator, called a hybrid coordinator (HC), and operates under rules that are different from the point coordinator (PC) of the PCF. The HC is collocated with the QAP of the QBSS and uses the HC's higher priority of access to the WM to initiate frame exchange sequences and to allocate TXOPs to itself and other QSTAs, so as to provide limited-duration controlled access phase (CAP) for contention-free transfer of QoS data. The HC traffic delivery and TXOP allocation may be scheduled during the CP and any locally generated CFP (generated optionally by the HC) to meet the QoS requirements of a particular TC or TS. TXOP allocations and contention-free transfers of QoS traffic can be based on the HC's QBSS-wide knowledge of the amounts of pending traffic belonging to different TS and/or TCs and is subject to QBSS-specific QoS policies. A QAP may indicate availability of

CF-Polls to non-QoS STAs, thereby providing non-QoS contention-free transfers during the CFP. This provisioning of contention-free transfers during the CFP to non-QoS STAs, however, is not recommended. QAP that provides non-QoS CF-polling to adhere to frame sequence restrictions considerably more complex than, and less efficient than, those specified for either PCF or HCF. In addition, the achievable service quality is likely to be degraded when non-QoS STAs are associated and being polled. The HCF protects the transmissions during each CAP using the virtual carrier sense mechanism. A QSTA may initiate multiple frame exchange sequences during a polled TXOP of sufficient duration to perform more than one such sequence. The use of virtual carrier sense by the HC provides improved protection of the CFP.

2.11 Admission Control (AC)[29]

Admission control play very vital role in QoS. it keeps obtainable time sensitive traffic at the same time as utilizing complete channel capacity

An 802.11e network may use admission control (AC) to administer policy or regulate the available bandwidth. AC is useful to handle congestion. AC ensures that admittance of a new flow into a resource constrained network does not violate parameterized service commitments made by the network to admitted flows. The HC, which is collocated at the QAP, either accepts or rejects the request based on an admission control policy. AC also may used to administer policy or regulate the available bandwidth resources. AC is also required when a QSTA desires guarantee on the amount of time that it can access the channel. The HC, which is in the QAP, is used to administer admission control in the network. As the QoS facility supports two access mechanisms, there are two distinct admission control mechanisms: one for contention-based access and another for controlled access. AC, in general, depends on vendors' implementation of the scheduler, available channel capacity, link conditions, retransmission limits, and the scheduling requirements of a given stream. All of these criteria affect the admissibility of a given stream. If the HC has admitted no streams that require polling, it may not find it necessary to perform the scheduler or related HC functions. There are two types of admission control: Contention Based Admission Control and Controlled Access Admission Control.

Table 2.4 Problem of 802.11e Performance in the presence of legacy 802.11

Researchers	Main involvement	Duration	Description
Ammar Abbas et al [12]	802.11e with 802.11	2009	Performed a comparative analysis of 802.11 and 802.11e in terms of medium access technique and management of multiple flows by using different traffic types Such as CBR, VBR and FTP.
Emanuel Puşchiţa and Tudor Palade [13]	Performance evaluatiD2on of EDCA with DCF	2009	Evaluated the performance of IEEE 802.11e EDCA compared to the legacy DCF QoS support on handling multimedia applications.
E. Karamad and F. Ashtiani [14]	Performance evaluation of 802.11 and	2008	Proposed an analytical model based on Baskett Chandy, Muntz and Palacios model closed

	802.11e		queuing networks and evaluated the performance of IEEE 802.11 and 802.11e MAC protocols.
Amal A. Alahmadi Mohamed A. Madkour [15]	Performance evaluation of 802.11e with 802.11	2008	EDCA is evaluated to verify that it achieves superior QoS performance for real-time applications compared with the earlier legacy IEEE 802.11 DCF access method.
Haithem Al-Mefleh, J. And Morris Chang[16]	EDCA with DCF	2008	Proposed a simple distributed management scheme (called NZ-ACK) to mitigate the influence of legacy DCF on EDCA performance in networks consisting of both types of users without any modifications to legacy users. Opnet simulation is used to evaluate the performance of NZ-ACK.

CHAPTER # 3

PROBLEM STATEMENT

Balakrishnan et al. [33] proposed channel pre-emption EDCA (CP-EDCA) scheme that provide full MAC support to emergency traffic in ad-hoc based distributed networks. Emergency traffic stream can break ongoing session and get the channel access by adjusting SIFS and SlotTime. This scheme is not suitable for dense networks.

3. Problem Scenario

This scenario CP-EDCA [33] uses the delay model in which it predict MAC delay per frame, which is the delay suffered by an application frame for successful one hope channel transmission. This model also allows non_ saturated traffic condition. This paper mentioned only the two categories of the emergency priorities and both priorities come in the normal categories but it changes the inter-frame spacing and slot time design for the purpose of preemption. These priorities levels are:

1) EMERGENCY PRIORITY SIFS =10μs it is first emergency level frame, it has smallest wait time to transmit frame .SIFS is equal to (MAC processing delays + receive or transmit around time). EPSlot TIME is equal to 25μs (EPSlot plus Clear Channel Access (CCA)). It also mention that each time value of slot time will be different.

2) NORMAL PRIORITY SIFS NPSIFS=40μs It is second level of the priority, frame always transmit TXOP are separated from their slot time, in which TXOP is enough time for every node, but if any one interrupt then time will be include now its NPSlot Time is equal 55μs and the time completion of priority if (NPSIF and plus Clear Channel Access) except emergency.

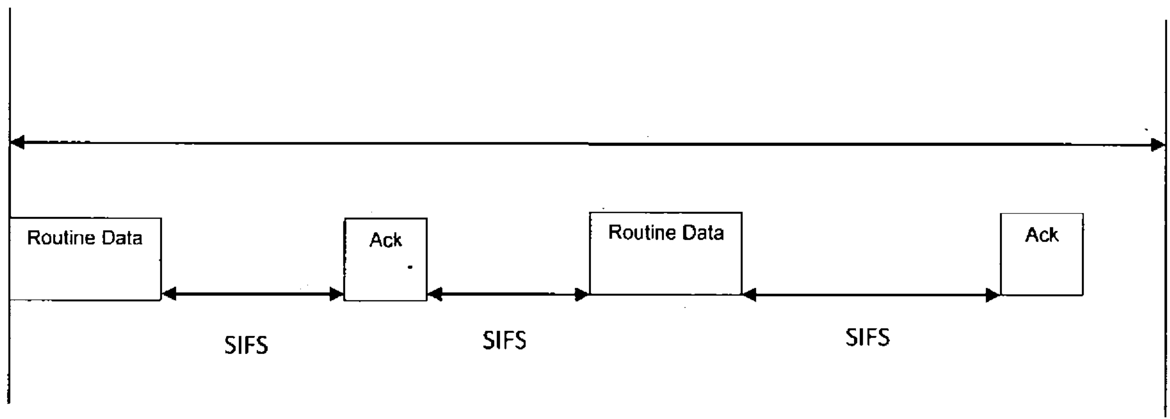


Figure 3.1..EDCA: CFB for All Frames

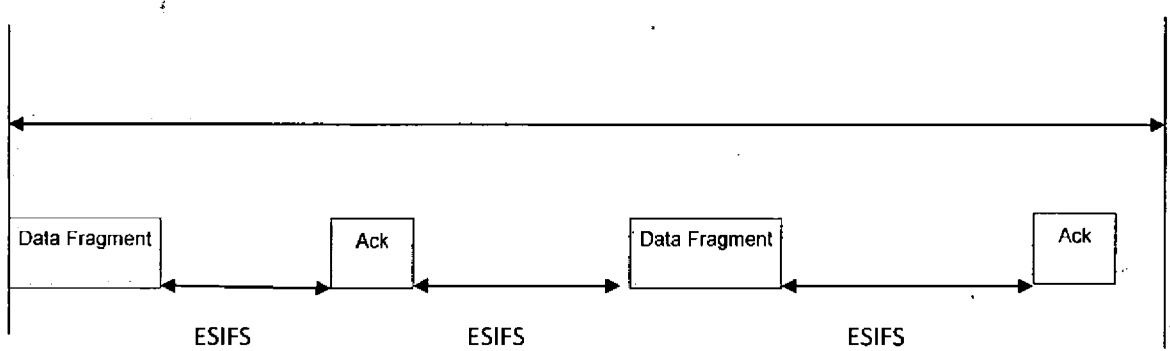


Figure 3.2..EDCA: Emergency for All Frames

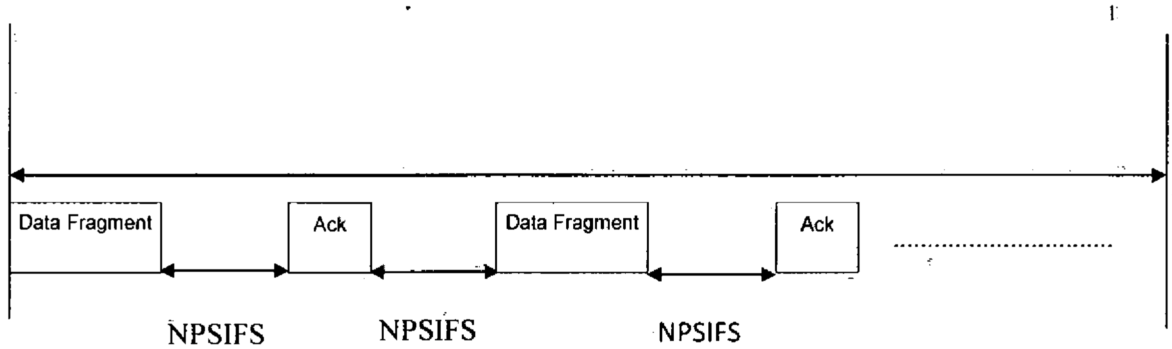


Figure 3.3..EDCA Normal Priority CFB for all frames

3.1 Research Objectives

The major topic of our research is to increase a better QoS via MAC protocol in situation of emergency traffic. For accomplishing the research plan, we suggest the following research objectives:

- To expand, high throughput of MAC protocol with QoS guarantee.
- To expend the QoS structure for Emergency traffic in wireless local area networks (WLAN).
- To introduce a new methods for supporting emergency traffic in dense situation in ad-hoc wireless local area networks (WLAN).

CHAPTER # 4

PROBLEM SOLUTION

4. Proposed Model

Growing handling of wireless networks keen on emergency services (disaster, tragedy telemedicine/ healthcare) and another serious application have burden of emergency service support. WLAN possibly will be best option for emergency networking because of its cost effective and quick deployment abilities. WLAN are estimate to support emergency services during dense network condition. Emergency service is guarantee of strict QoS. when Strict QoS guarantee does not support by IEEE 802.11e (EDCA)

Balakrishnan et al. [33]CP-EDCA doesn't work on dense emergency situation

Generally research [53-55] usually classified the emergency as follows: (1) Life emergency, (2) fitness, (3) property and (4) one is environment dependant Emergency. Life has uppermost priority because nothing is essential than life, than fitness, property and forth depend on environments

The majority of the emergency organizations consider that life saving manners should have highest priority after that fitness, property and environment.

To increase the use of WLANs into emergency services (disaster, telemedicine/healthcare) and additional time essential application [9], emergency services cooperate a very significant role in WLAN. Necessities of emergency service are strict QoS guarantee with a few channel pre-emption mechanisms to maintain emergency traffic. Even strict QoS guarantee does not support by IEEE 802.11e (EDCA).

We suggest Emergency Frame Work For EDCA (EF-EDCA) scheme, this scheme classify in four parts. When 802.11e EDCA work on emergency service during distributed network operation for saturated emergency traffic conditions the EF-EDCA scheme will permit high priority emergency frames for break off and swap the channel services in low priority traffic. EF-EDCA will give a deterministic QoS rather than probabilistic, to emergency traffic in distributed ad-hoc networks during dense emergency situation.

4.1 Emergency Frame Work EF- EDCA

In-channel pre-emption idea is exemplified in Fig 4.2. A higher priority emergency queue has the chance to stop the on-going TXOP burst of another low priority queues. The stopped queue will back-off and compete after the high priority emergency bursting. The slot time and inter-frame space [22] are extended to support multiple level pre-emption for emergency transmission, that are depth literature below for 802.11b radios.

Furthermore EF-EDCA model utilize prioritized queuing, contention free bursting (CFB) schemes of EDCA and contention mechanism, CFB allow adjacent transmission of more than one frames with no contention during TXOP period.

1) Threat to Life SIFS (TtoLSIFS) = 10μs that is similar to SIFS: Minimum time required in Phy/MAC processing + Receive/Transmit turnaround time. Threat to Life frame burst are divide by TtoLSlotTime, for that reason these can never be interrupted.

2) TtoLSlotTime = 25µs (TtoLSIFS + CCA time): The slot time for threat to Life priority that is dissimilar from all other priorities. Clear channel assiment (CCA) time is necessary to discover emergency in the wireless medium after the transmission starting from a new node that is just about 15µ.

3) Threat to fitness (TtoFSIFS) = 25 µs (TtoFSIFS + CCA time): Wait for TtoSIFS if no emergency frame burst in queue, sense the channel for idle and transmit the frame.

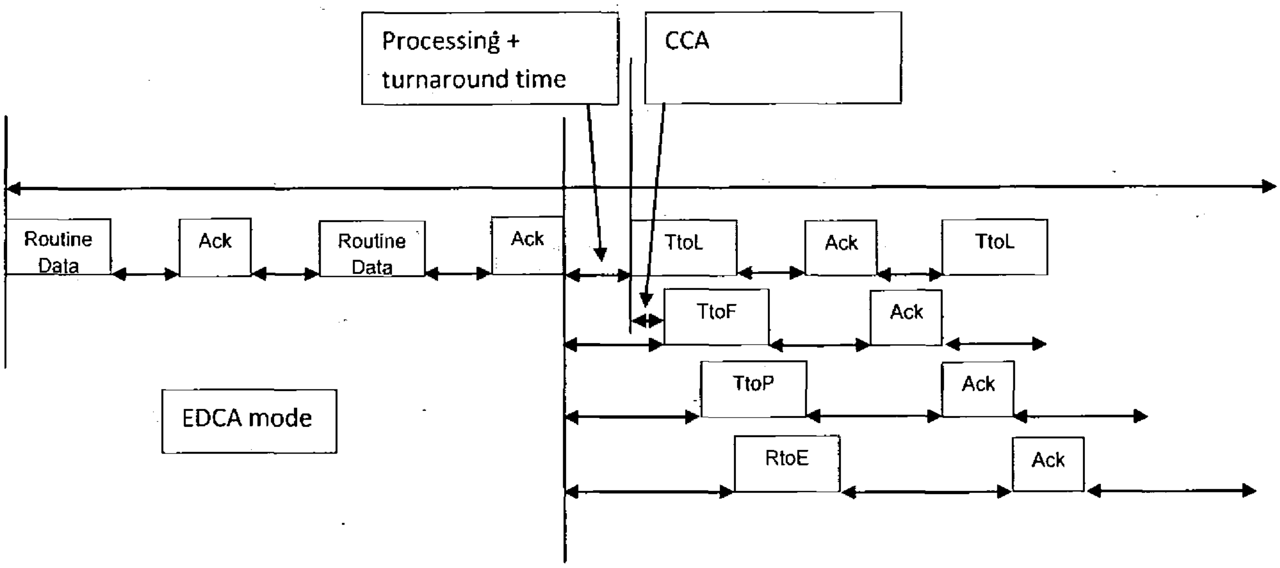


Figure 4.1. Multiple QoS in terms of Emergency Frame Work in WLANs

4) TtoFSlotTime = 40µs (TtoFSIFS + CCA time): The slot time for threat to fitness priority that is different from slot time TtoLSlotTime and a normal slot time.

5) Threat to Property (TtoPSIFS) = 40µs (TtoPSIFS + CCA time): Wait for TtoFSIFS time if no emergency to life and emergency to health fitness frame burst in queue, sense the channel for idle and transmit the frame.

6) TtoPSlotTime = 55µs (TtoPSIFS + CCA time): The slot time for Threat to Property that is different from slot time TtoLSlotTime, TtoFSlotTime and normal priority slot time.

7) Threat to Environment (TtoESIFS) = 55µs (TtoPSIFS + CCA time): stay for TtoLSIFS, TtoFSIFS and TtoPSIFS, if no emergency to life, health fitness and property burst in queue, sense the channel for idle and transmit the frame.

8) TtoESlotTime = 70µs (TtoESIFS + CCA time): The slot time for Threat to Environment is different from TtoLSiotTime and TtoFSlotTime, TtoPSlotTime and a normal slot time.

9) Normal Priority SIFS (NPSIFS) through emergency = 70µs (TtoESIFS + CCA time): Wait for TtoLSIFS, TtoFSIFS and TtoPSIFS, if no emergency to life, health for fitness and property explode in queue, sense the channel for idle and transmit the frame.

10) NPSIFS = 85µs (NPSIFS + CCA time): The slot time for normal priority during emergency is dissimilar from TtoLSlotTime and TtoFSlotTime, TtoPSlotTime and TtoESlotTime.

An ongoing risk to life burst has highest priority (TtoLSIFS), followed by risk to health, fitness, risk to property, risk to environment and finally normal frames respectively.

Figure 4.1 exemplifies the process of Multiple QoS, terms of Emergency Frame Work in WLANs.

New risks to life emergency frames are transmitted if the channel is sensed idle for EPAIFS period, which is smallest then all other priorities.

4.2 Scenario of Proposed Model

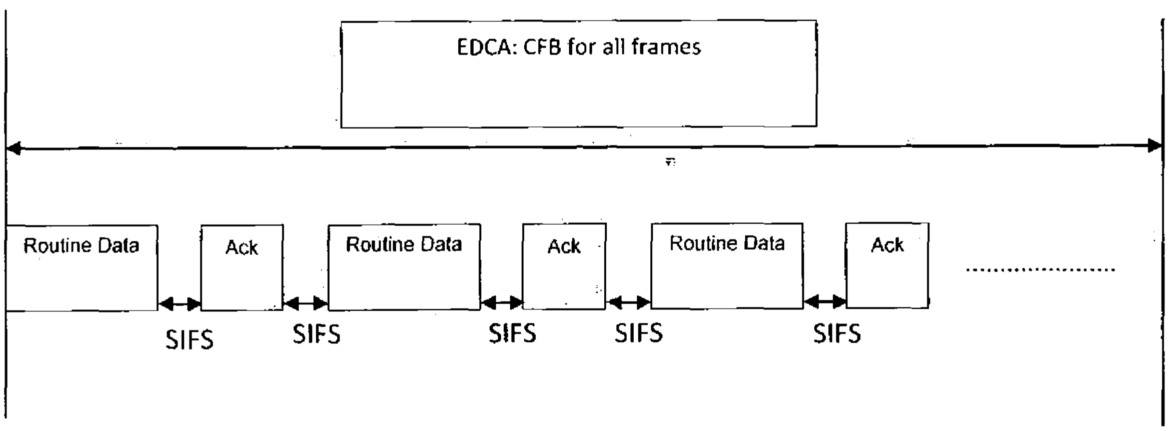


Figure 4.2. Multiple QoS ,in terms of emergency services

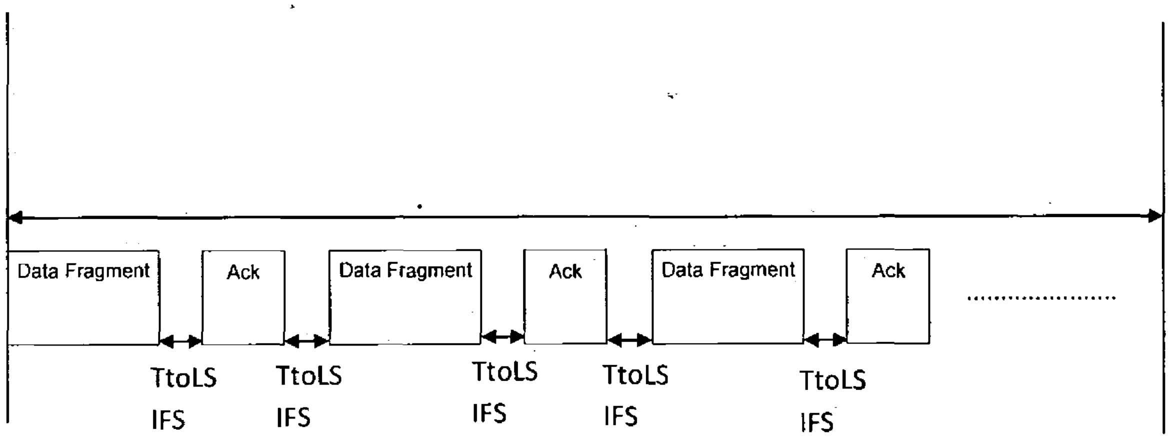


Figure 4.3. EF-EDCA: Threat to life: CFB for all frames

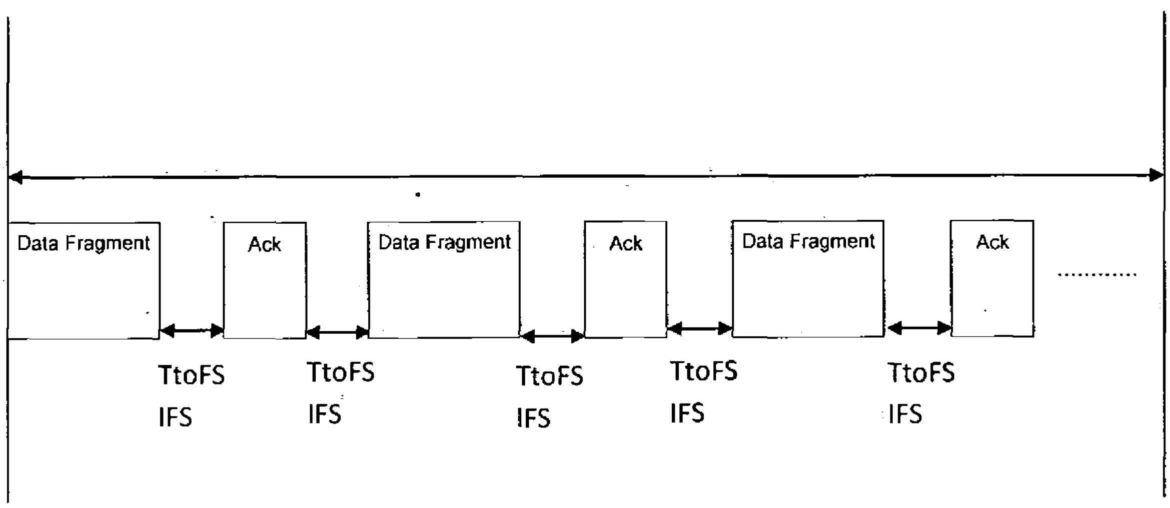


Figure4.4. EF-EDCA: Threat to Health/fitness: CFB for all frames

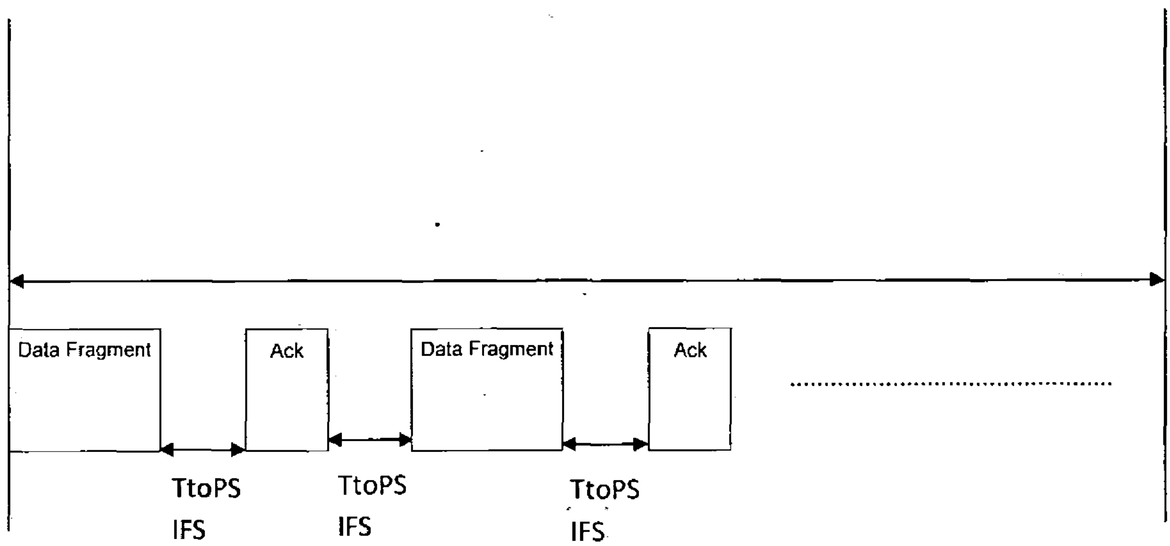


Figure 4.5. EF-EDCA: Threat to Property: CFB for all frames

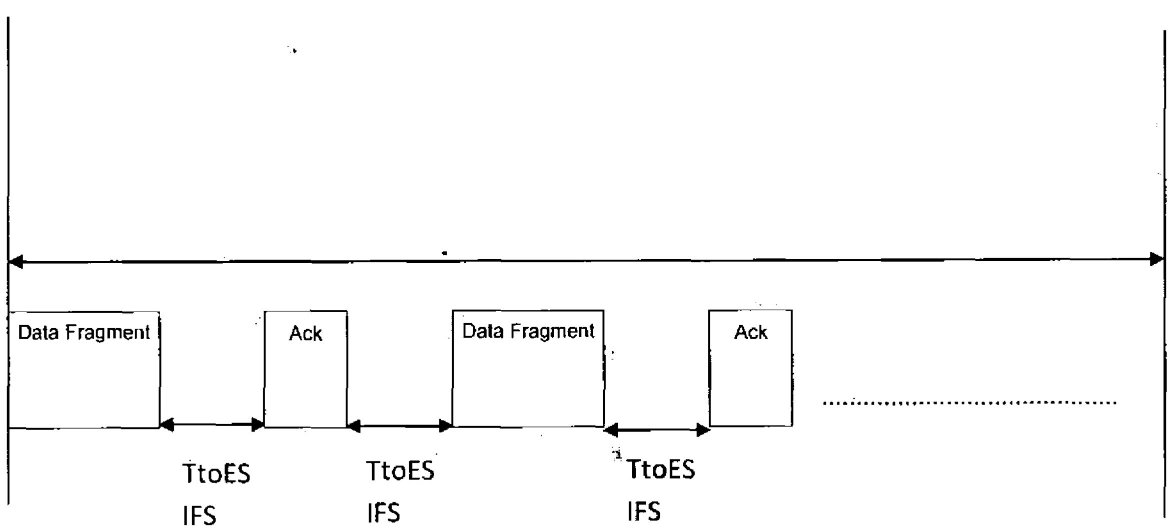


Figure 4.6. EF-EDCA: Risk to Environment depend emergency: CFB for all frames

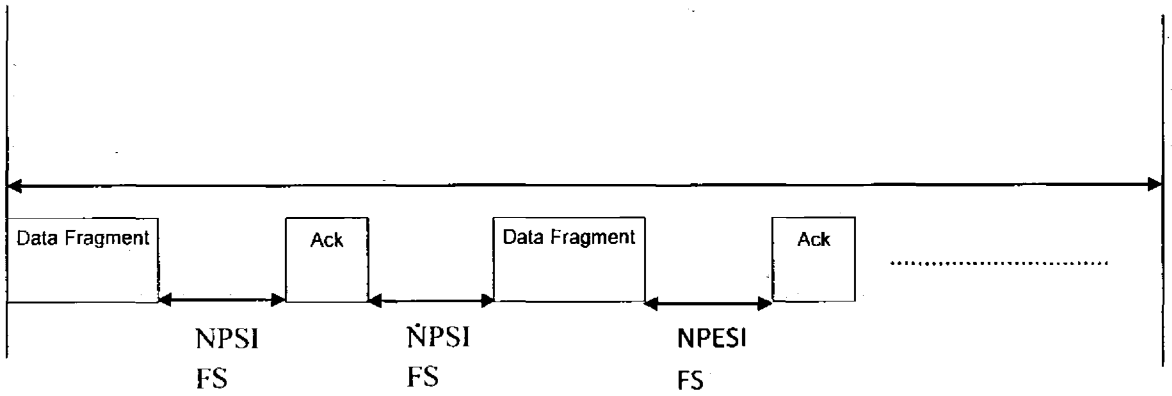


Figure 4.7. EF-EDCA: Regular Priority : CFB for all frames

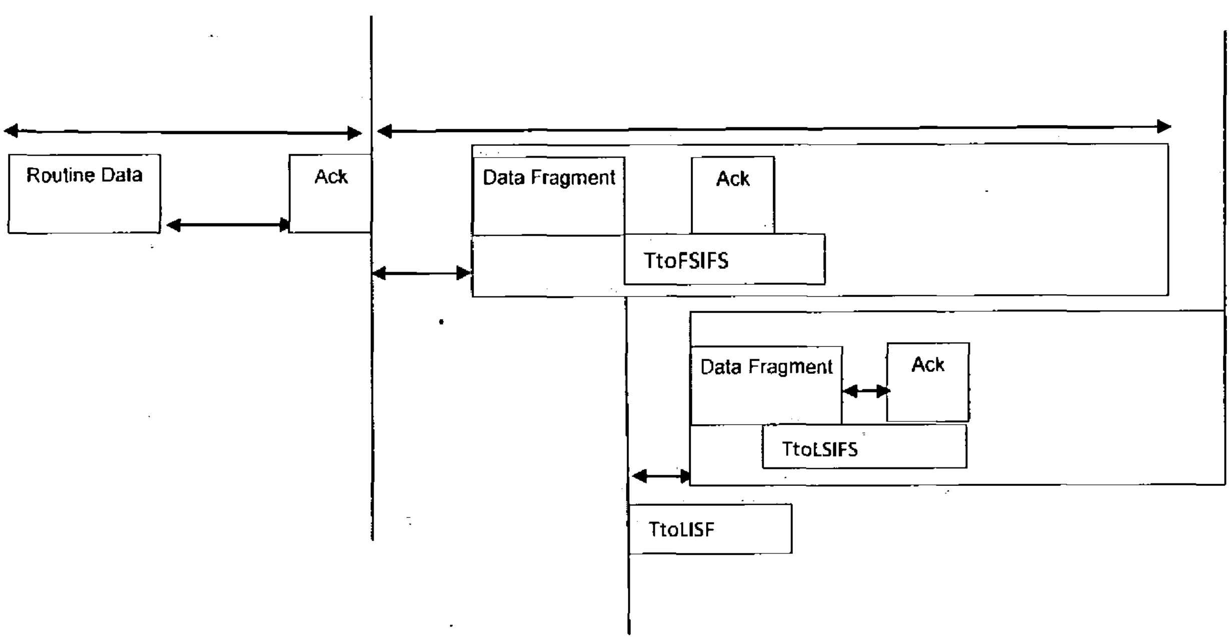


Figure 4.8. Multiple QoS in the terms of emergency services WLAN mode

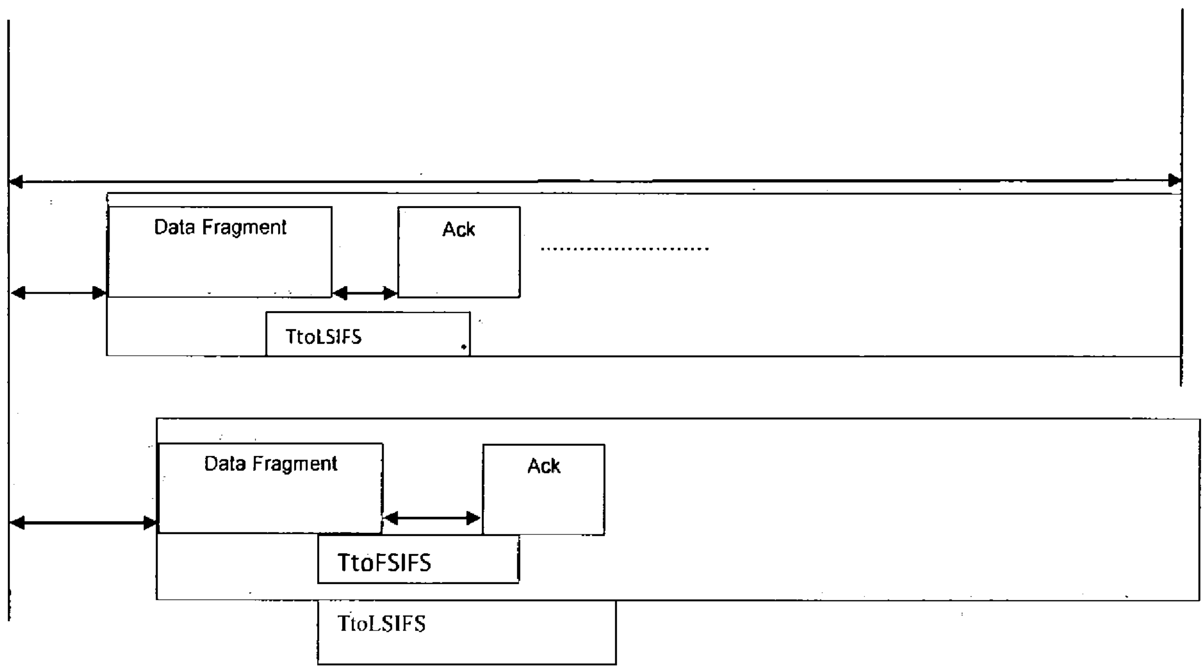


Figure 4.9. Multiple QoS in the terms of emergency services WLAN mode

Since TtoLSIFS < TtoFSIFS < TtoPSIFS < TtoESIFS < RPSIFS

And TtoLSlotTime < TtoFSlotTime < TtoPSlotTime < TtoESlotTime < RPSlotTime

Figure 4.9. Frame Multiple QoS in term of Emergency Frame Work in WLAN

original high priority emergency frame will end the current low priority flow for receiving the pre-emption in first try and after that stay for its slot time which is smaller than low priority emergency flow (Fig. a and b), thus permitting routine TXOP preemptions.

4.3 Coding Of Proposed Model

Emergency Priority SIFS (EPSIFS) = SIFS = 10: Smallest wait time between frame transmissions (PHY/MAC processing delays + Receive/Transmit turnaround time), Emergency frame bursts are separated by EPSIFS, so that they can never be interrupted.

EPSlotTime = 25μs (EPSIFS + CCA time): The slot time for emergency priority, which is different from the slot time for other priorities (unlike standard EDCA). Clear Channel Assessment (CCA) time is the time taken to detect energy in the medium after a transmission initiation from another node, which is approximately 15μs. In CP-EDCA, the AIFS duration [3] for emergency priority (EPAIFS) is one EPSlotTime.

```
/* coding for emergency frame work EDCA */

printf(" toe flag = %d ",toe_flag);

        if (toe_flag == 1)
        {
        printf("emer to life ");
        sifs_time = 10E-06;
        slot_time = 25E-06;
        }
        if (toe_flag == 2)
        {
        printf("emer to health");
        sifs_time = 25E-06;
        slot_time = 40E-06;
        }
        if (toe_flag == 3)
        {
        printf("emer to property");
        sifs_time = 40E-06;
        slot_time = 55E-06;
        }
        if (toe_flag == 4)
```

```
{
printf("emer to environment ");
sifs_time = 55E-06;
slot_time = 70E-06;
}
if (toe_flag ==0)

{
printf("No emergency");
sifs_time = 70E-06;
slot_time = 85E-06;
}
```

4.3.1. Threat to Life

An immediate attention is required for a number of emergencies because of instant threat to human life. These emergencies may be a medical emergency affecting individual or affecting on large scale in shape of fire or natural disasters.

4.3.2. Risk to Health

Some emergencies might have serious implications for the continued health and well-being of a person(s) (although a health emergency can subsequently escalate to be threatening to life) but.these emergencies are not considered as immediate threatening to life. There are normally similar causes for "Health emergency" and

"Emergency threatening to life, which includes medical emergencies and natural disasters, although the range of incidents that can be categorised here is far greater than those that cause a danger to life (such as broken limbs, which do not usually cause death, but immediate action is required to recover the person.

4.3.3. Risk to Property

Few emergencies might not threaten to individuals, but can affect the property and infrastructure, like fire in a warehouse and this situation is treated as an emergency as the fire may spread to other buildings, or may cause sufficient damage to make unable to continue the business and indirectly affecting the livelihood of the employees.

It is categorised a bit lower nature of emergency by some agencies, and may not take risks associated in dealing with fire. For instance, fire-fighters are unlikely to enter an empty burning building and taking the risk is unjustified comparing where the people are reported as trapped.

4.3.4. Risk to the Environment

Some emergencies may only affect environment and creatures living within it but not directly to the human life, health or property. It is not considered as genuine emergency, but it can affect the land for long term and animals and various creatures. Examples can be marine oil spills and forest fires.

CHAPTER # 5
IMPLEMENTATION

In this chapter implementation mechanism and implementation theory has been explained and discuss 1st implement the existing model is done and secondly implement the 2nd model and finally compare with both.

5. Implementation Environment

The OPNET Modeler used in[41], a primary tool of OPNET modeler I s to give the model of networks and simulation networking modeling and simulate the networks so that's We continue to perform network modeling and simulation activities with OPNET Modeler. OPNET Modeler is chosen because it is most widely used by network research and development (R&D) community for analyzing and designing communication networks, devices, protocols and applications [42]. OPNET Modeler presents complete set of tools and a model library to design, develop and analyze any sort of communication network [43].

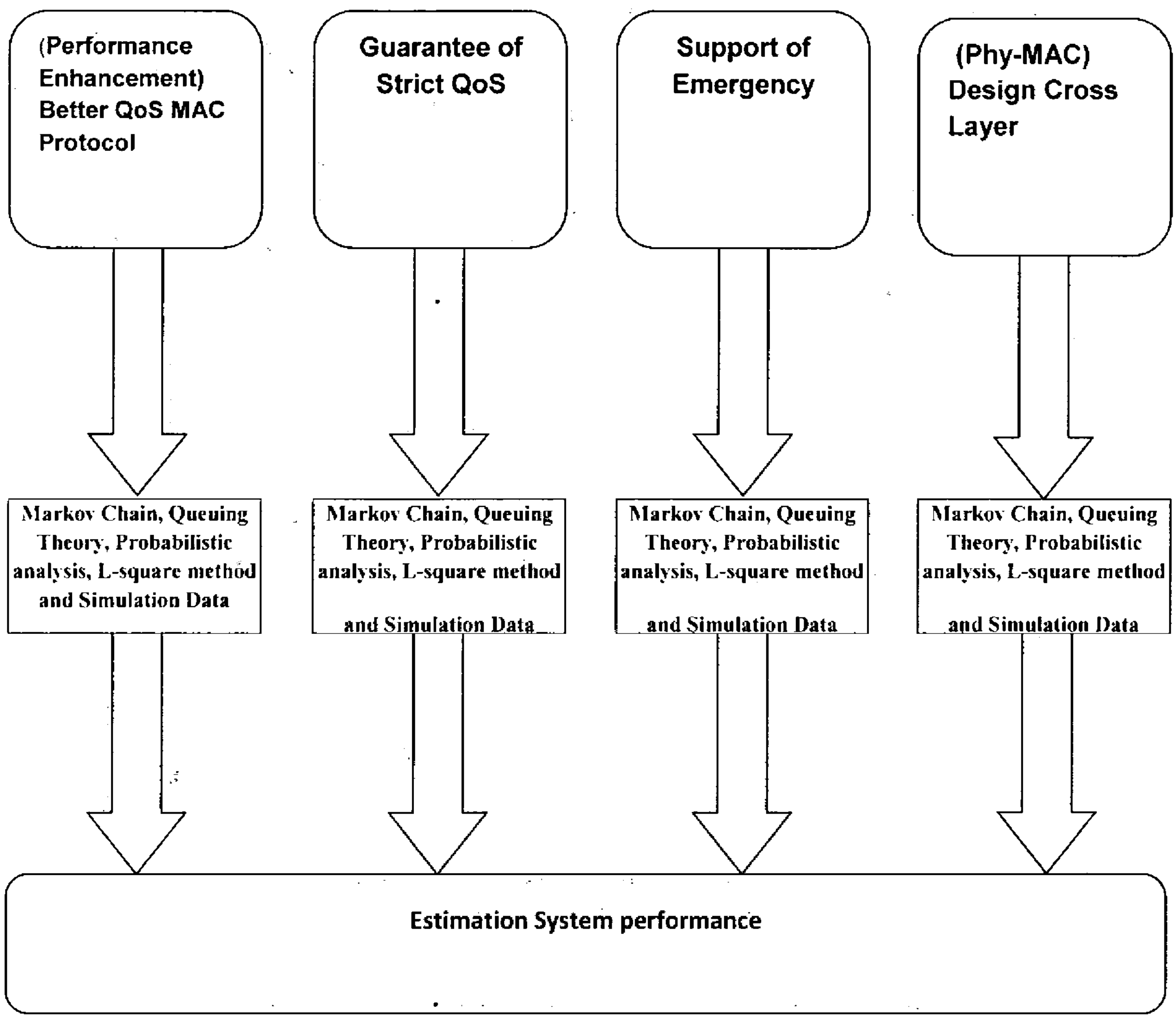


Figure 5.1. Diagram for Tentative Methodology for Investigation.

To design a high throughput MAC we proposed Simple Block Acknowledgement Scheme. We combine IEEE 802.11e frame to eliminate protocol overhead.

Frame aggregation/combining is very important for high speed PHY. For example, if we can eliminate one SIFS which is equal to 16us and transmit user data instead, one more packet of length 432 bytes can be served with 216Mbps PHY. [Reference, High Throughput MAC by Yaw 2009].

We propose to combine frame of the IEEE 802.11e, some protocol overhead is eliminated and the number of admitted flows can be increased.

Table 5.1. An Example of Effective Data Rates (Throughput) Offered By 802.11 WLANs [18]

Standard	Maximum Throughput	Achievable Throughput 2 active users (Normal – Perfect Condition	Medium traffic 5 active users	High traffic 10 active users
802.11a (OFD)	54 Mbps	11 – 17 Mbps	5 – 7 Mbps	2 – 3 Mbps
802.11b (DSSS)	11 Mbps	3 – 5 Mbps	1 – 2 Mbps	500 Kbps – 1 Mbps
802.11g (CCK, OFDM)	54 Mbps	11 – 17 Mbps	5 – 7 Mbps	2 – 3 Mbps

From Paper QoS Guarantee Techniques For VoIP Over IEEE 802.11 WLAN.

None of the commercial IEEE 802.11 WLAN based VoIP products can support more Than ten G.729 quality voice conversations over a single IEEE 802.11b channel on real world WLANs, even the physical rate is more than two orders of magnitude higher than an individual VoIP connections' bandwidth requirements. There are two main reasons why these VoIP systems' effective throughput is significantly lower than expected: VoIP's stringent latency requirement and substantial per WLAN packet overhead

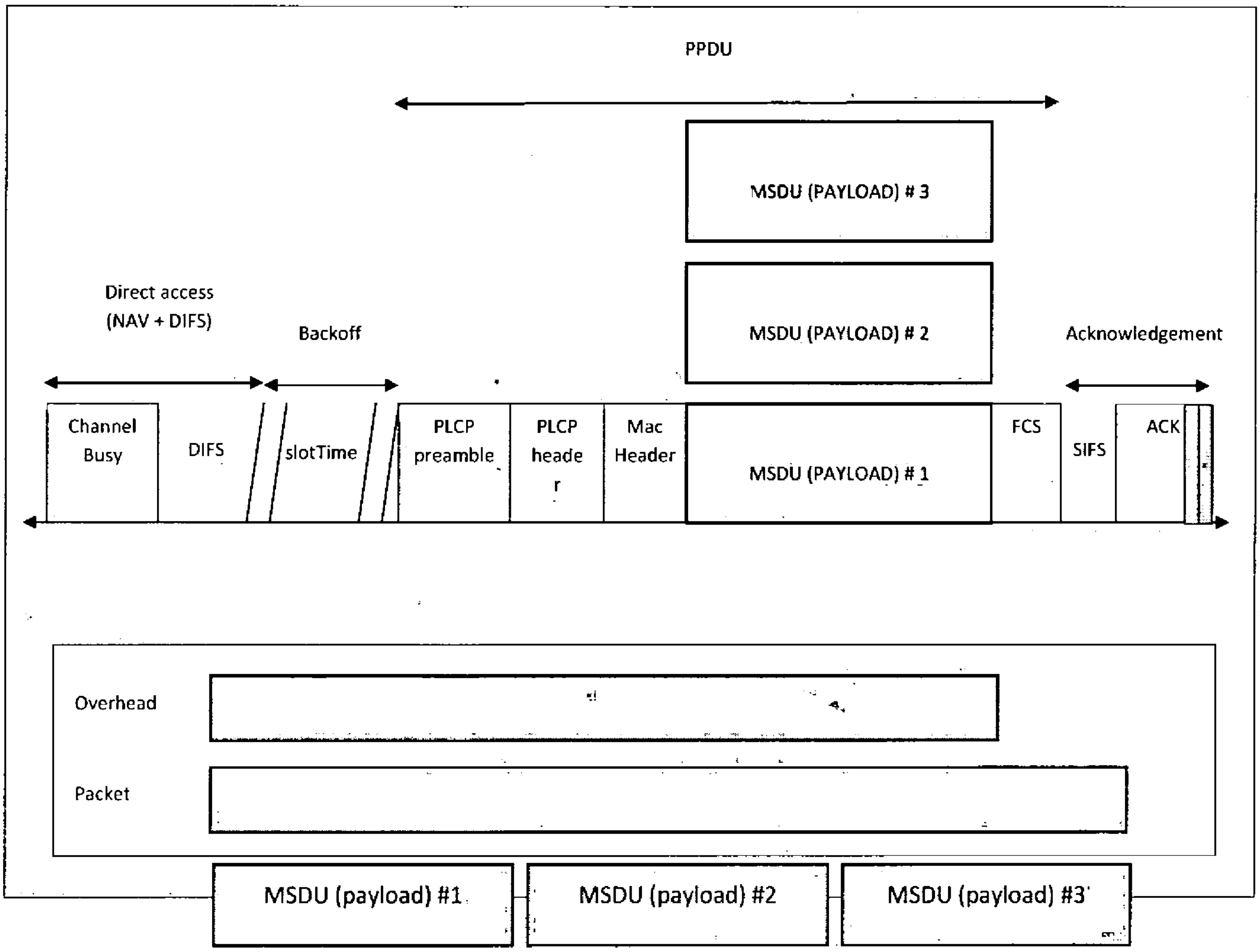


Figure 5.2. ANS_DCF_EDCF Basic Operations.

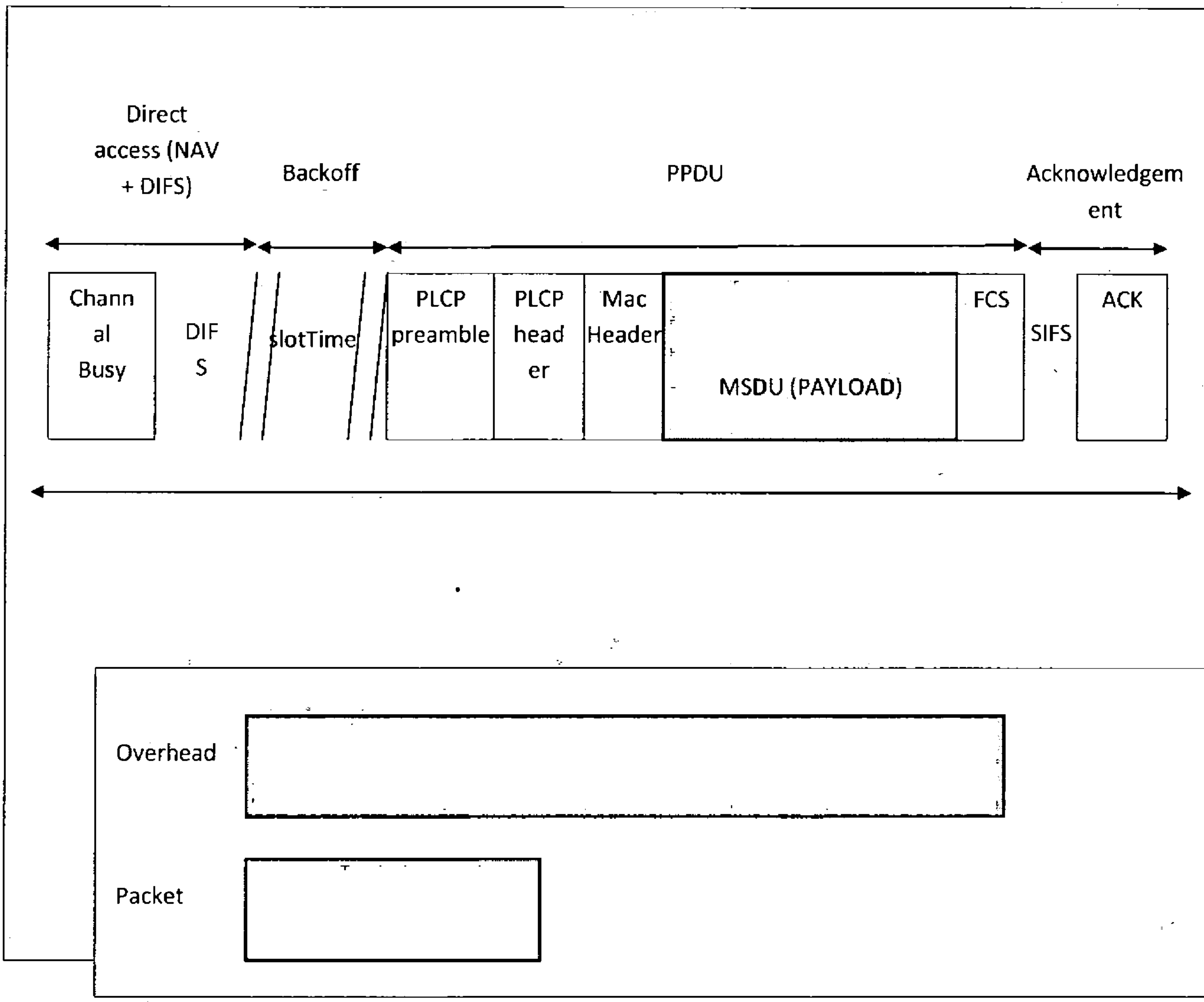


Figure5.3. ANS_MAC By Simple Modification In The Existing MAC

We proposed ANS_MAC which can be implemented by simple modification in the existing MAC.

Table 5.2. Two Bit Block Acknowledgement

Two bit Acknowledgement	Purpose	Next packets
11	Frame / Packet received successfully. Transmit another one.	4, 5, and 6
01	Only resend packet 1, (packet # 2 and #3 received successfully).	1, 4, and 5
10	Only resend packet 3, (packet # 1 and #2 received successfully)	3, 4, and 5
00 / None	Resend (all three packets).	1, 2, and 3

To design of a high throughput MAC with QoS guarantee.

IEEE 802.11e introduces the Hybrid Coordination Function (HCF), which has two medium access methods one is compulsory, contention based, "Enhanced Distributed Channel Access (EDCA)" and second is optional "HCF Controlled Channel Access (HCCA)"[7]

In last few years demand of high speed applications over WLANs increased tremendously. However, IEEE 802.11 medium access control (MAC) is known to be limited throughput performance due its high overhead, e.g. MAC headers, per frame basis acknowledgement [1,2].

IEEE 802.11e introduced a new optional mechanism called block acknowledgement which is now compulsory part of High Throughput 802.11n WLANs [7].

Achieved throughput is well below than theoretical maximum throughput because of the existing MAC and PHY overhead [4, 5]

Many researches such as [1], [4], [5], [6], [7], [8] have been carried out to enhance the performance in terms of throughput by aggregating frames and using block acknowledgements.

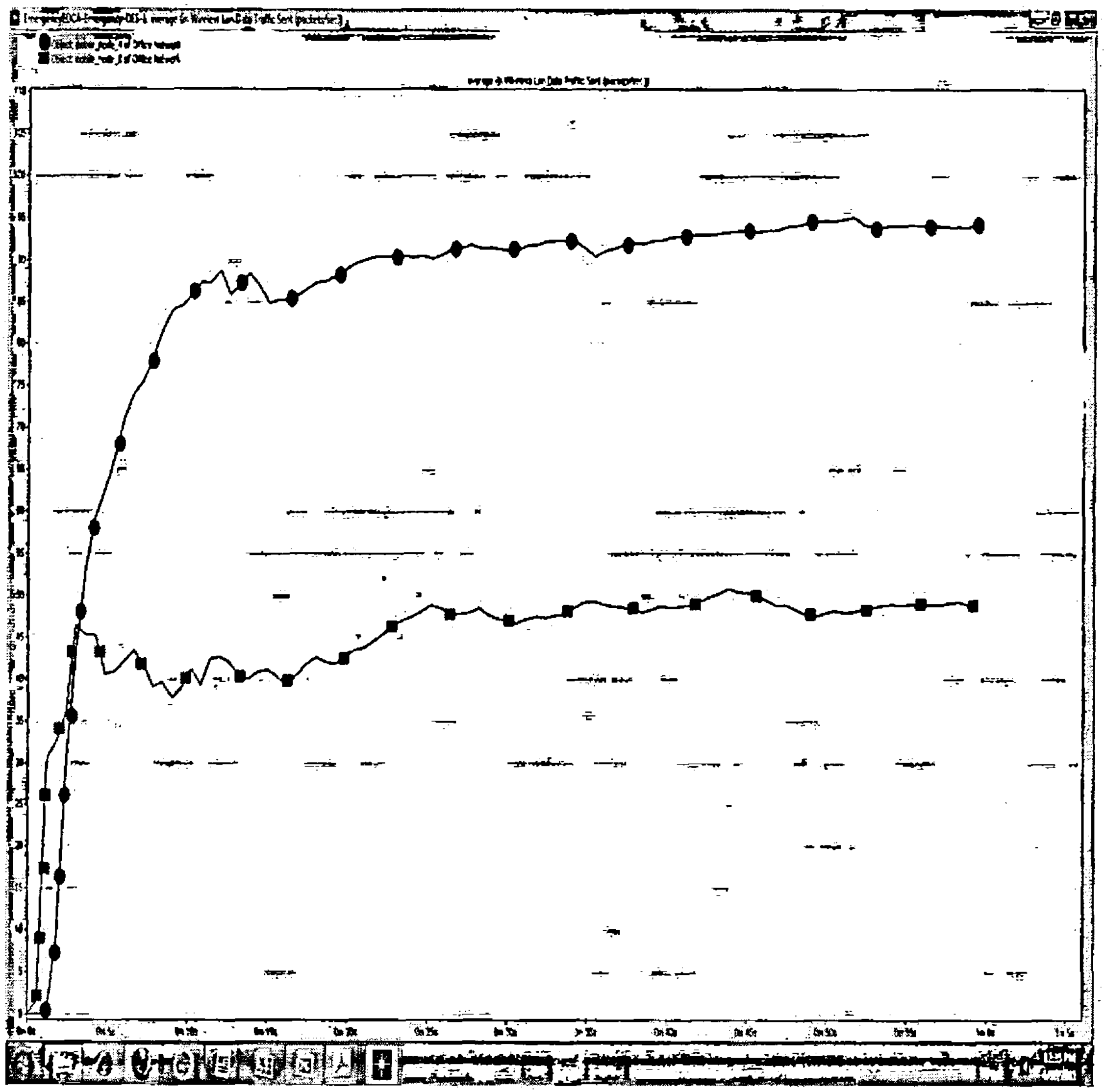
Most of the frame aggregation methods are complex or they only used ideal environment (channel error free).

The work done by [9], [10], and [11] focus on block acknowledgment in the environment with channel errors. They all used complex long acknowledgement schemes.

5.1 Implementation Process

- Giving priority to Emergency Node
- Scenario
- Implementing Emergency Attribute
- Modifying Code (WLAN Process Model)
- Modifying Process Models (WLAN MAC, WLAN MAC HCF, WLAN dispatch)
- Modifying Node Models (WLAN station and Router)
- Challenges

5.2. Giving Priority to Emergency Traffic Node



x- axis show the time and y-axis mention the delays

Figure5.4. Throughput: Blue line (squire doted) for Emergency Node and Red line (circle doted) for Normal node.

5.2.3 Emergency Scenario

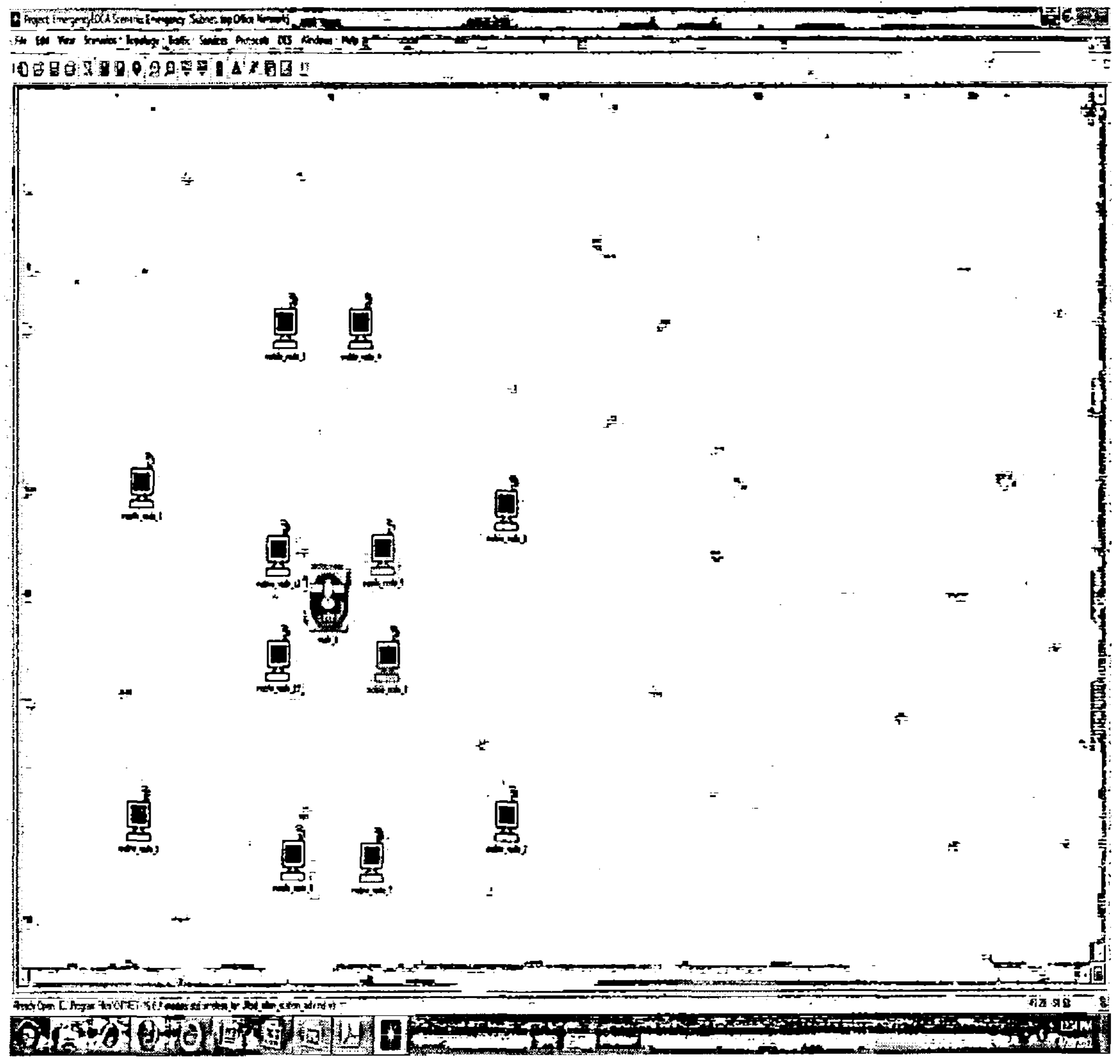


Figure 5.5. Total 12 nodes, 11 normal nodes and 1 Emergency node

5.2.4 Default Attributes

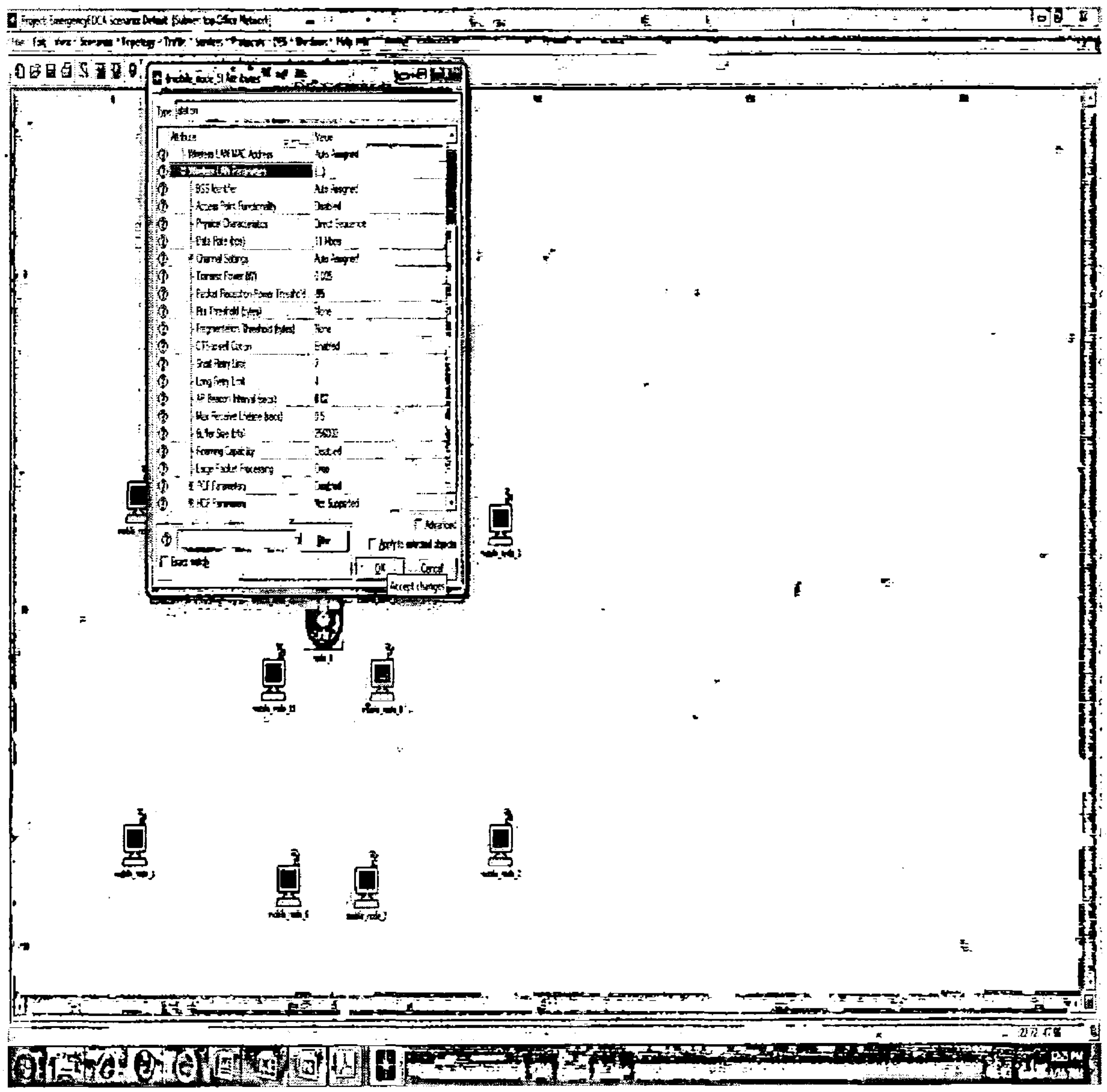


Figure 5.6. New attribute called Emergency

5.2.5 Modifying Code (WLAN MAC Process Model)

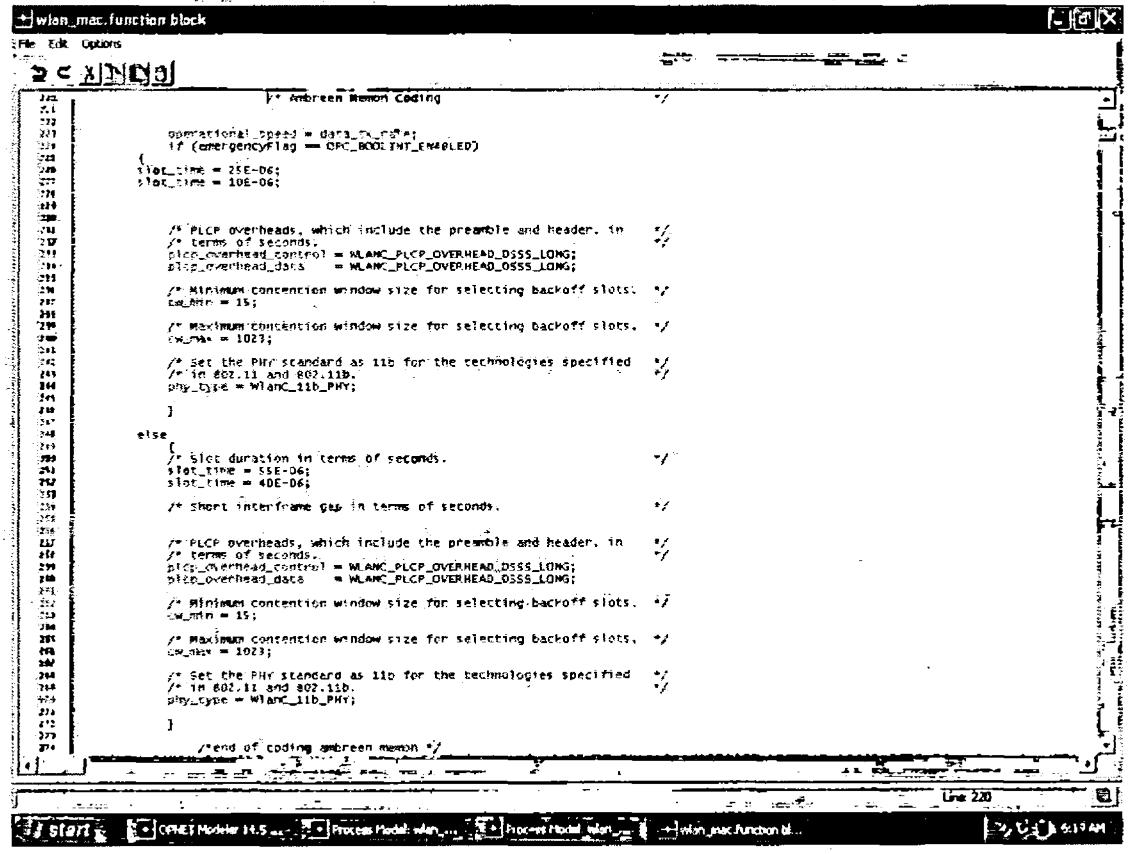


Figure 5.7. Change the code of 802.11 WLAN MAC

5.2.6. WLAN MAC Process Model

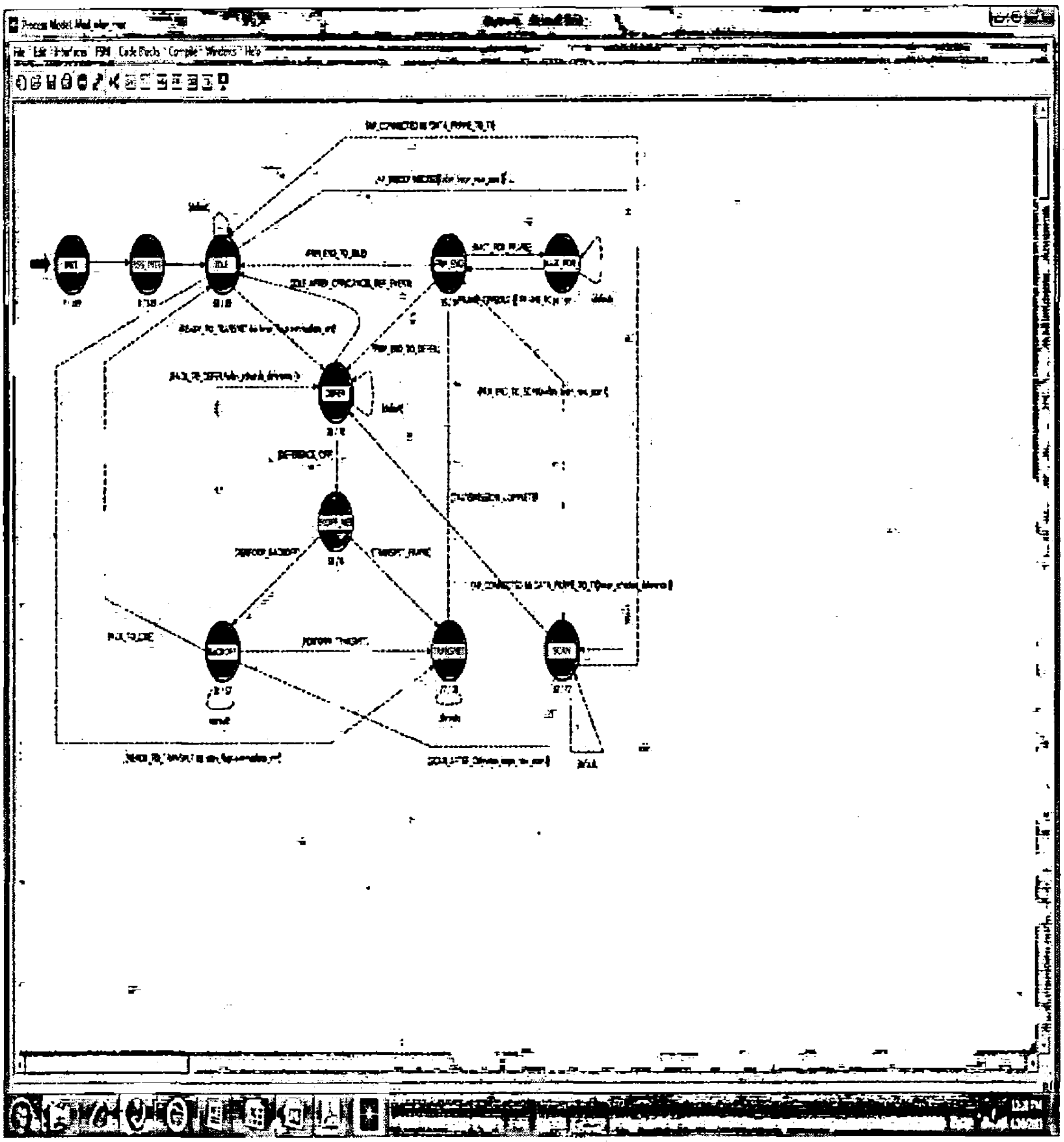


Figure 5.8. WLAN MAC process model

5.2.7. WLAN Dispatch Model

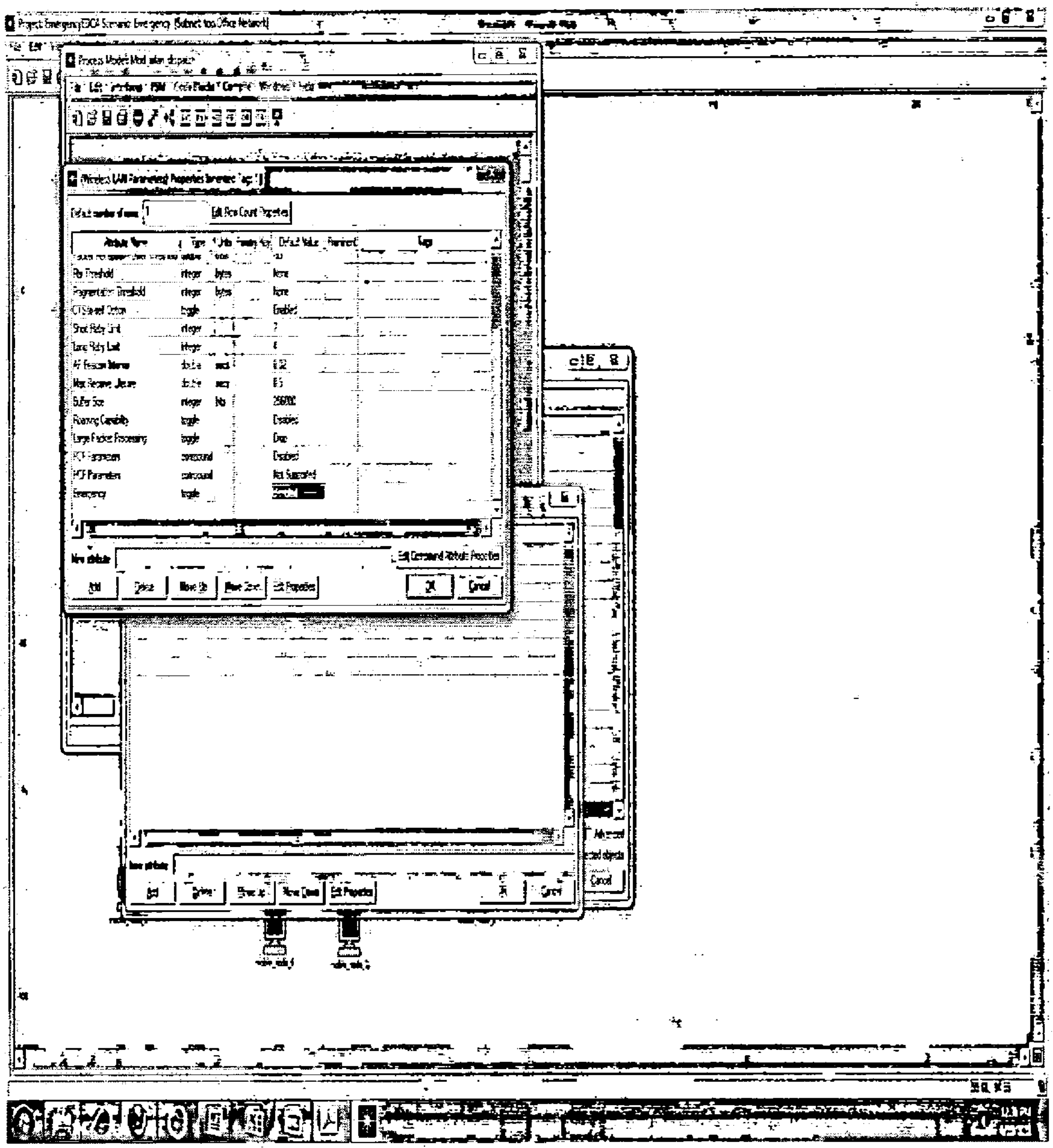


Figure.5.9 Emergency Attribute

5.2.8 WLAN Router

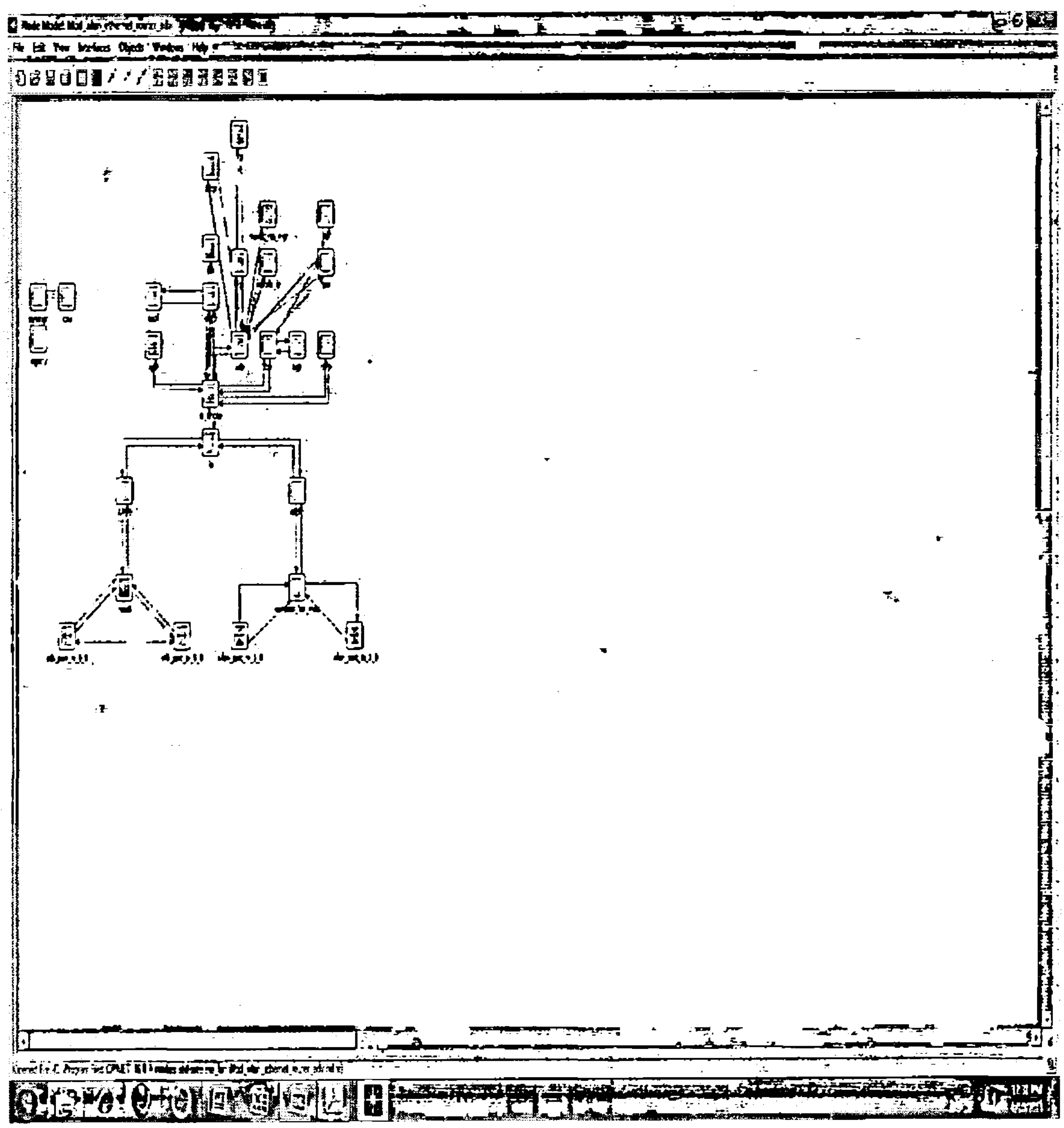


Figure 5.10. Router

5.2.9. WLAN Station

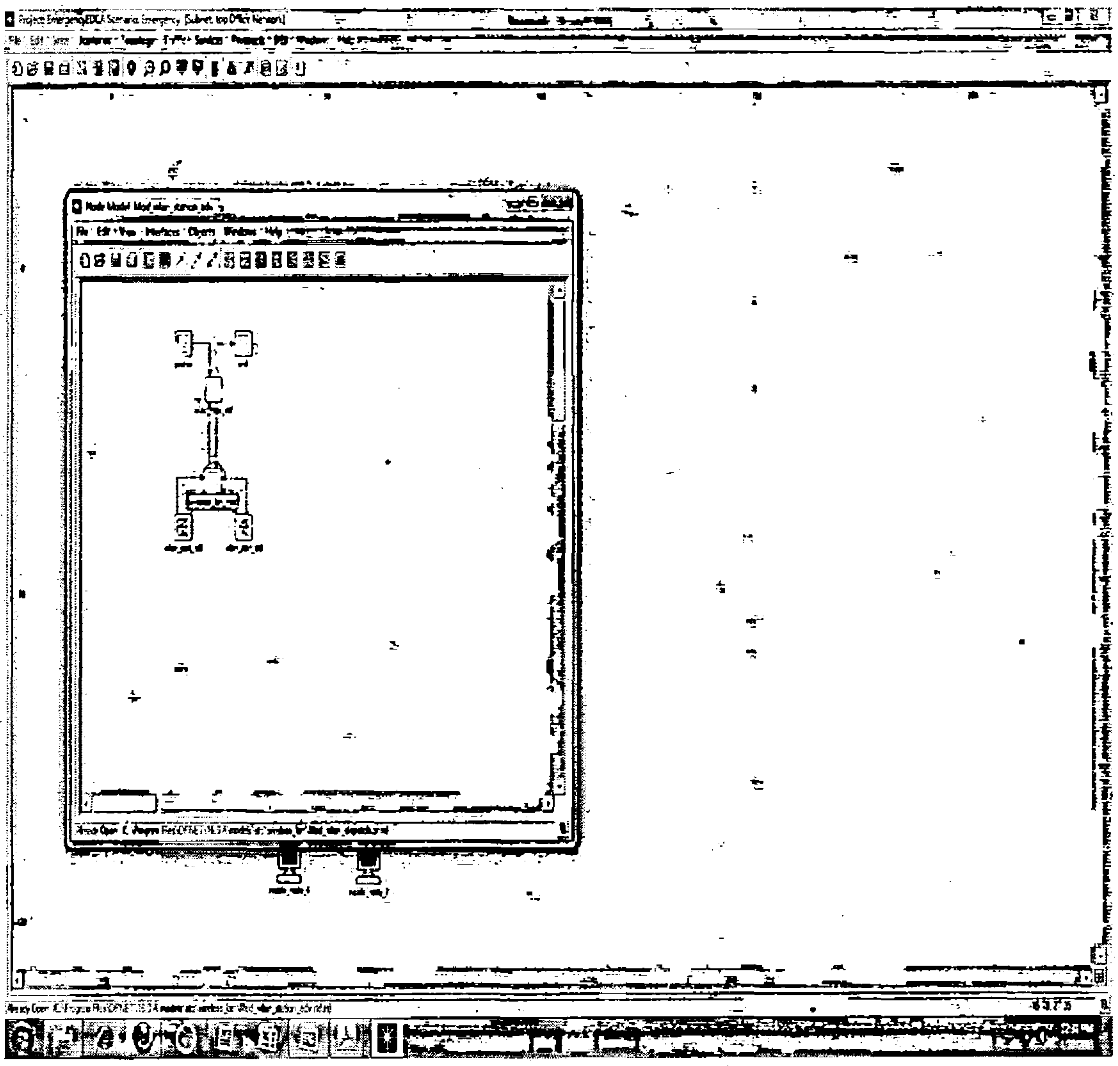


Figure 5.11. Station

5.2.10. WLAN State Variables

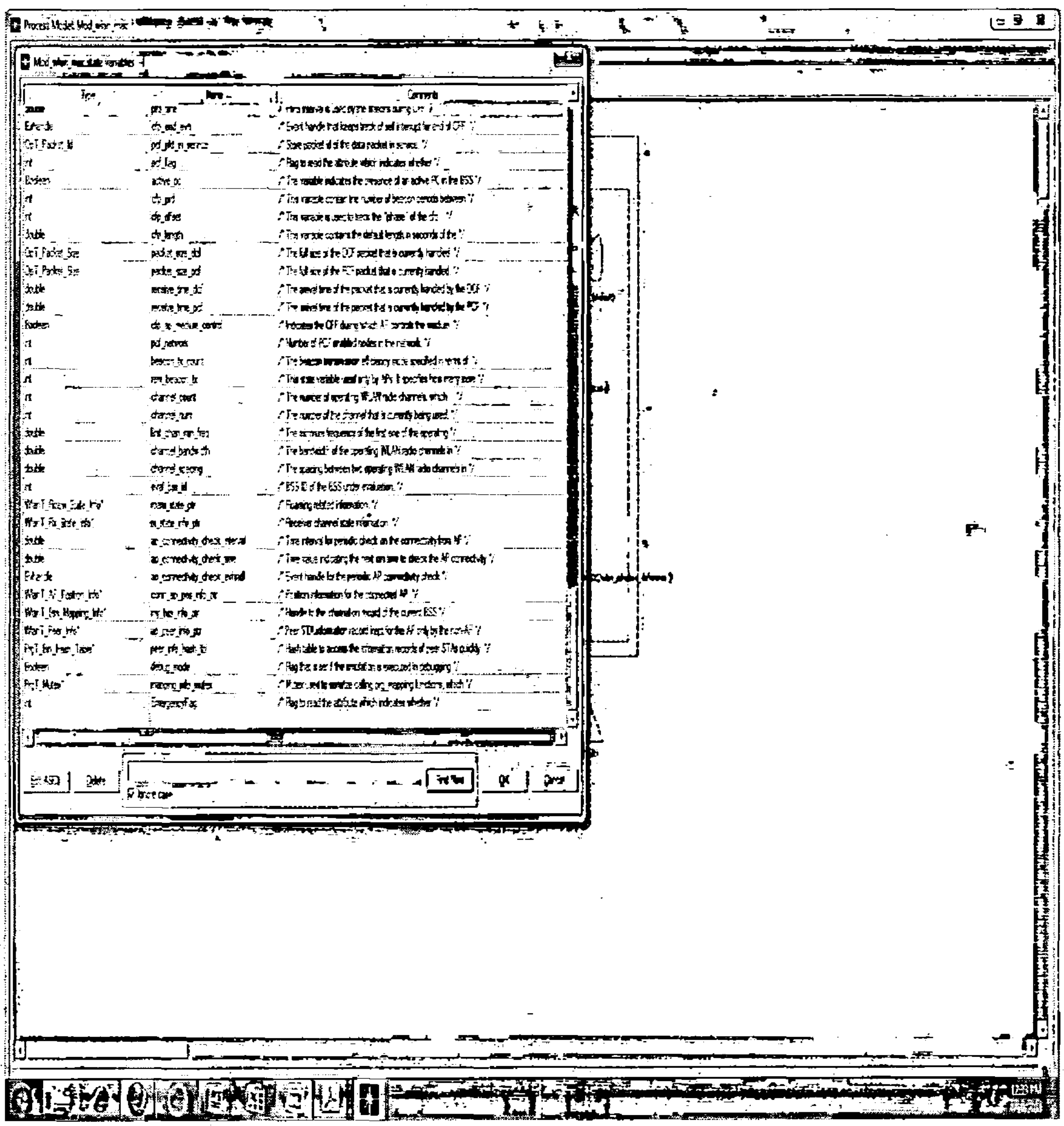


Figure 5.12. WLAN State Variables

Outcome: Preliminary results shows that by modifying Physical characteristics (SlotTime, SIFS and etc) of WLAN and some other parameters (CWmin, CWmax, AIFS and etc), we can give priority to emergency traffic.

To achieve the outcome we modified, WLAN MAC, WLac MAC HCF, WLAN Dispatch process models, WLAN Station and WLAN Router.

Introduced a new emergency type attribute for node, modified existing physical characteristics values.

5.3 Existing Model

EDCA scheme in channel service pre-emption methodology.[5] this scheme enhance the EDCA protocol that allow emergency frames to interrupt and replace the channel services of the low priority in the network. It also mention that EDCA I allow deterministic (no randomly select the channel) rather than randomly channels selection. This research improves/performs the QoS for emergency traffic during distributed (ad-hoc /wireless network) network operation.

This model also work on 802.11e standards that support centralize polling scheme HCF Controlled Channel Access (HCCA). These are highly effective regular delay but they have poor performance in irregular emergency arrivals. It is necessary to use EDCA method in unpredictable emergency arrivals. EDCA is easily scalable and we can easily operate in Ad-hoc mod.

In the channel pre-emption CP-EDCA scheme[33], after channel acquisition, CP-EDCA fit in the emergency pre-emption during the channel transmission, the CP-

EDCA also uses CFB (contention free bursting) mode. It allows contiguous transmission of multiple frames for transmission opportunity (TXOP) duration without further delay. CFB supply the best throughputs and also improvement in capacity-limited wireless networks, it also mention the channel TXOP preemption and emergency TXOP

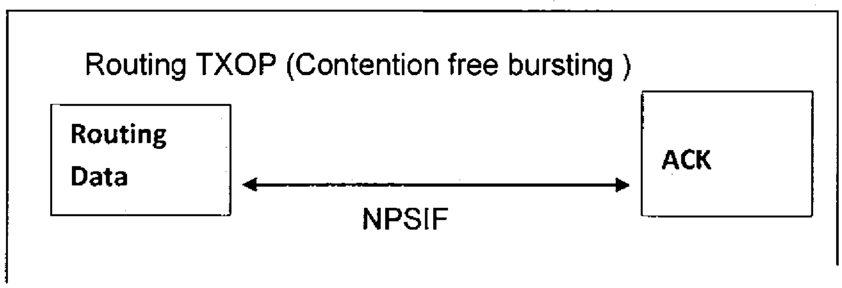


Figure 5.13. Routine traffic but if emergency will occur

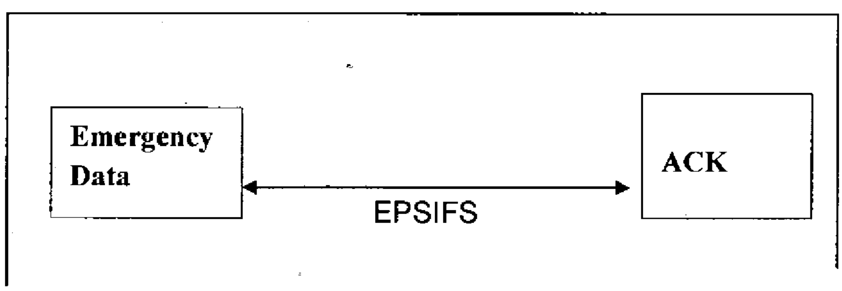


Figure 5.14. Emergency TXOP

CP-EDCA use the delay model in which it predict MAC delay per frame, which is the delay suffered by an application frame for successful one hop channel transmission. This model also allow non_ saturated traffic condition. In the CP EDCA mentioning the two categories of the priorities, both emergency priorities come in normal categories but it changes the inter-frame spacing and slot time design for the purpose of preemption. These priorities levels are:

1) **EMERGENCY PRIORITY SIFS** =10µs it is first emergency level frame it has smallest wait time to transmit frame .SIFS is equal to (MAC processing delays + receive or transmit around time). EPSlot TIME it is equal 25µs (EPSlot plus clear channel Access (CCA)) it also mention that each time value of slot time will be different.

2) **NORMAL PRIORITY SIFS NPSIFS=**40µs it is second level of the priority, frame always transmit TXOP are separated NPSLOT in which TXOP is enough time for every node, but if any one interrupt then time will be include now its NPSlot Time is equal 55µs and the time completion of priority if (NPSIF and plus clear channel access) except emergency.

5.3.1 Channel Service Time Model

In this part consist on 3rd Markova chain and their analysis of EDCA [8] it consist on saturated, unsaturated, load traffic contention window size and range .in this Markova EDCA consist on process queue and queue is consist on three state 1) A back of state 2) B back of counter value 3) C the time of the slot of last (AIFS)0 period

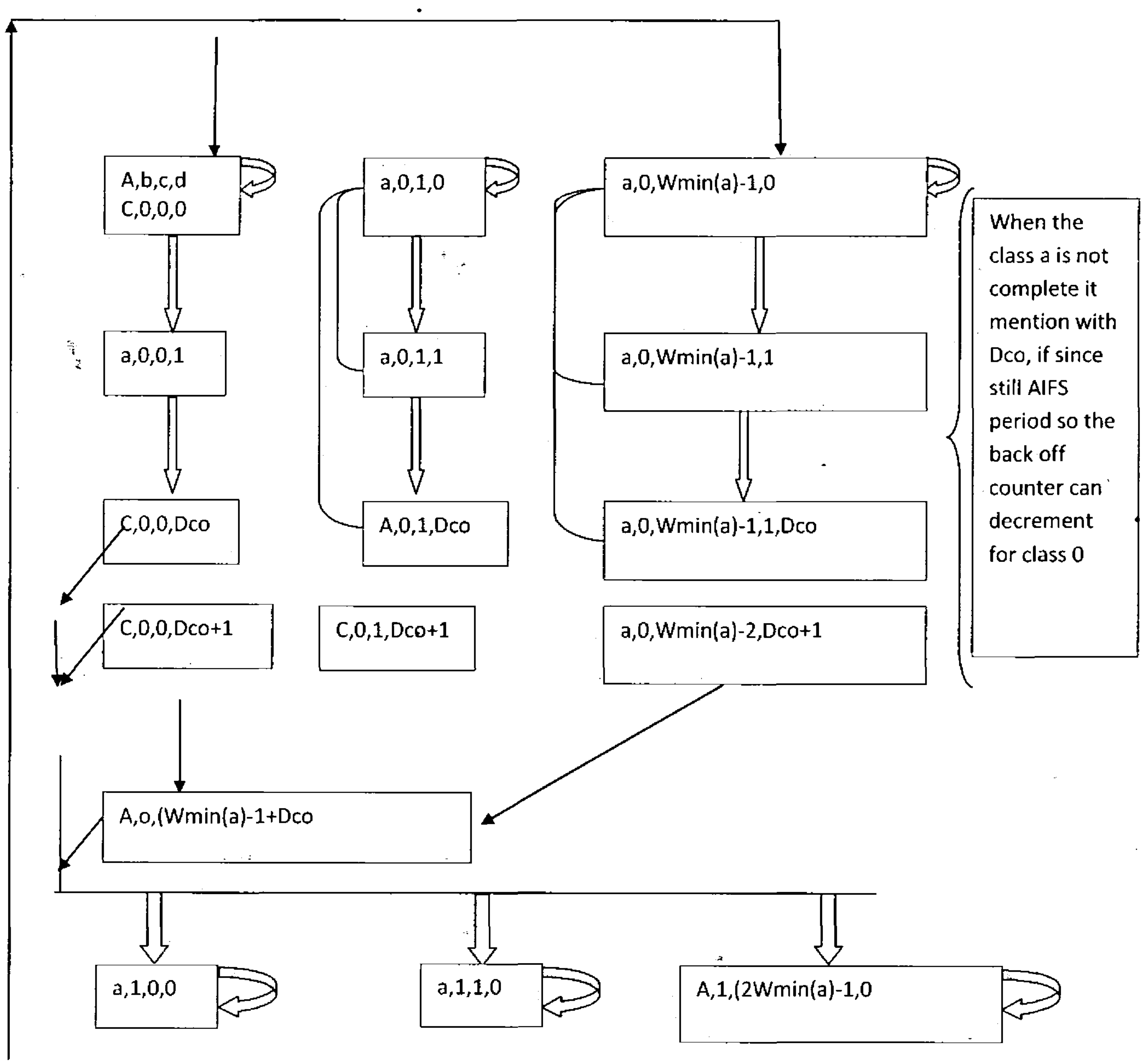


Figure 5.15. Markov Chain Model

5.4 Differentiation between Proposed and Existing Model

Balakrishnan et al. [12]CP-EDCA doesn't work on dense emergency situation

Generally research [53-55] usually classified the emergency as follows: first Life emergency, second fitness, third property and forth one is environment dependant Emergency. Life has uppermost priority because nothing is essential than life, than fitness, property and forth depend on environments

The majority of the emergency organizations consider that life saving manners should have highest priority after that fitness, property and environment.

To increase the use of WLANs into emergency services (disaster, telemedicine/healthcare) and additional time essential application [9], emergency services cooperate a very significant role in WLAN. Necessities of emergency service are strict QoS guarantee with a few channel pre-emption mechanisms to maintain emergency traffic. Even strict QoS guarantee Does not support by IEEE 802.11e (EDCA).

We suggest In-channel four Pre-emption EDCA (EF-EDCA) scheme, because this scheme classify in four parts. When 802.11e EDCA work on emergency service during distributed network operation for saturated emergency traffic conditions the EF-EDCA scheme will permit high priority emergency frames for break off and swap the channel services in low priority traffic. EF-EDCA will give a deterministic QoS rather than probabilistic, to emergency traffic in distributed ad-hoc networks during dense emergency situation.

5.4.1 Emergency Frame work EF- EDCA

In-channel pre-emption idea is exemplified in Fig 4.3. A higher priority emergency queue has the chance to stop the on-going TXOP burst of another low priority queues. The stopped queue will back-off and compete after the high priority emergency bursting. The slot time and inter-frame space [22] are extended to support Emergency Frame pre-emption for emergency transmission, that are depth literature below for 802.11b radios.

Furthermore EF-EDCA model utilize prioritized queuing, contention free bursting (CFB) schemes of EDCA and contention mechanism, CFB allow adjacent transmission of more than one frames with no contention during TXOP period.

1) Threat to Life SIFS (TtoLSIFS) = 10µs that is similar to SIFS: minimum time required in Phy/MAC processing + Receive/Transmit turnaround time. Threat to Life frame burst are divide by TtoLSlotTime, for that reason they can never be interrupted.
2) TtoLSlotTime = 25µs (TtoLSIFS + CCA time): The slot time for threat to Life priority that is dissimilar from all other priorities. Clear channel assiment CCA time is necessary to discover emergency in the wireless medium after the transmission starting from a new node that is just about 15µ.
3) Threat to fitness (TtoFSIFS) = 25 µs (TtoFSIFS + CCA time): Wait for TtoSIFS if no emergency frames explode in queue, logic is that the channel for idle and send out the frame.

4) TtoFSlotTime = 40µs (TtoFSIFS + CCA time): The slot time for threat to fitness priority that is different from slot time TtoLSlotTime and a normal slot time.

5) Threat to Property (TtoPSIFS) = 40µs (TtoPSIFS + CCA time): Wait for TtoFSIFS time if no emergency to life and emergency to health fitness frame burst in queue, sense the channel for idle and transmit the frame.

6) TtoPSlotTime = 55µs (TtoPSIFS + CCA time): The slot time for Threat to Property that is different from slot time TtoLSlotTime, TtoFSlotTime and normal priority slot time.

7) Threat to Environment (TtoESIFS) = 55µs (TtoPSIFS + CCA time): stay for TtoLSIFS, TtoFSIFS and TtoPSIFS, if no emergency to life, health fitness and property burst in queue, sense the channel for idle and transmit the frame.

8) TtoESlotTime = 70µs (TtoESIFS + CCA time): The slot time for Threat to Environment is different from TtoLSlotTime and TtoFSlotTime, TtoPSlotTime and a normal slot time.

9) Normal Priority SIFS (NPSIFS) through emergency = 70µs (TtoESIFS + CCA time): Wait for TtoLSIFS, TtoFSIFS and TtoPSIFS, if no emergency to life, health for fitness and property explode in queue, sense the channel for idle and transmit the frame.

10) NPSIFS = 85µs (NPSIFS + CCA time): The slot time for normal priority during emergency is dissimilar from TtoLSlotTime and TtoFSlotTime, TtoPSlotTime and TtoESlotTime.

A continuing risk to life explode has highest priority (TtoLSIFS), followed by risk to health, fitness risk to property, risk to environment and finally normal frames respectively.

New risks to life emergency frames are transmitted if the channel is sensed idle for EPAIFS period, which is smallest then all other priorities.

CHAPTER # 6

RESULTS

In this chapter implementation result have been discussed and explained by graphs. These results show the effectiveness of proposed solution ,It shows that objectives stated previous chapter have been achieved.

Introducing the Emergency Frame work (EF-EDCA) Channel Service Preemption by using the medium access control protocol (MAC) to support a better quality of services (QoS). it improves the performance of typical WLAN. Emergency frame work design QoS model specially for dense situations , it also develop a new MAC protocol that is a emergency traffic and provide strict QoS guarantee to time sensitive application with high throughput and achieve complete relative analysis

6. Channel preemption EDCA (CP-EDCA)

This existing model has implemented only two preemption level of emergency where as our Emergency Frame work model mentions the four level of emergency These level are explained in pervious chapter in detail.

- Emergency to life
- Emergency to health
- Emergency to property
- Emergency to environment

Now we discuss the results of End to End delay and Node Delay. Which we receive on the basis of four preemption EDCA. In previous work author compare his results with EDCA but EF-EDCA compare with two graphs CP-EDCA and EDCA

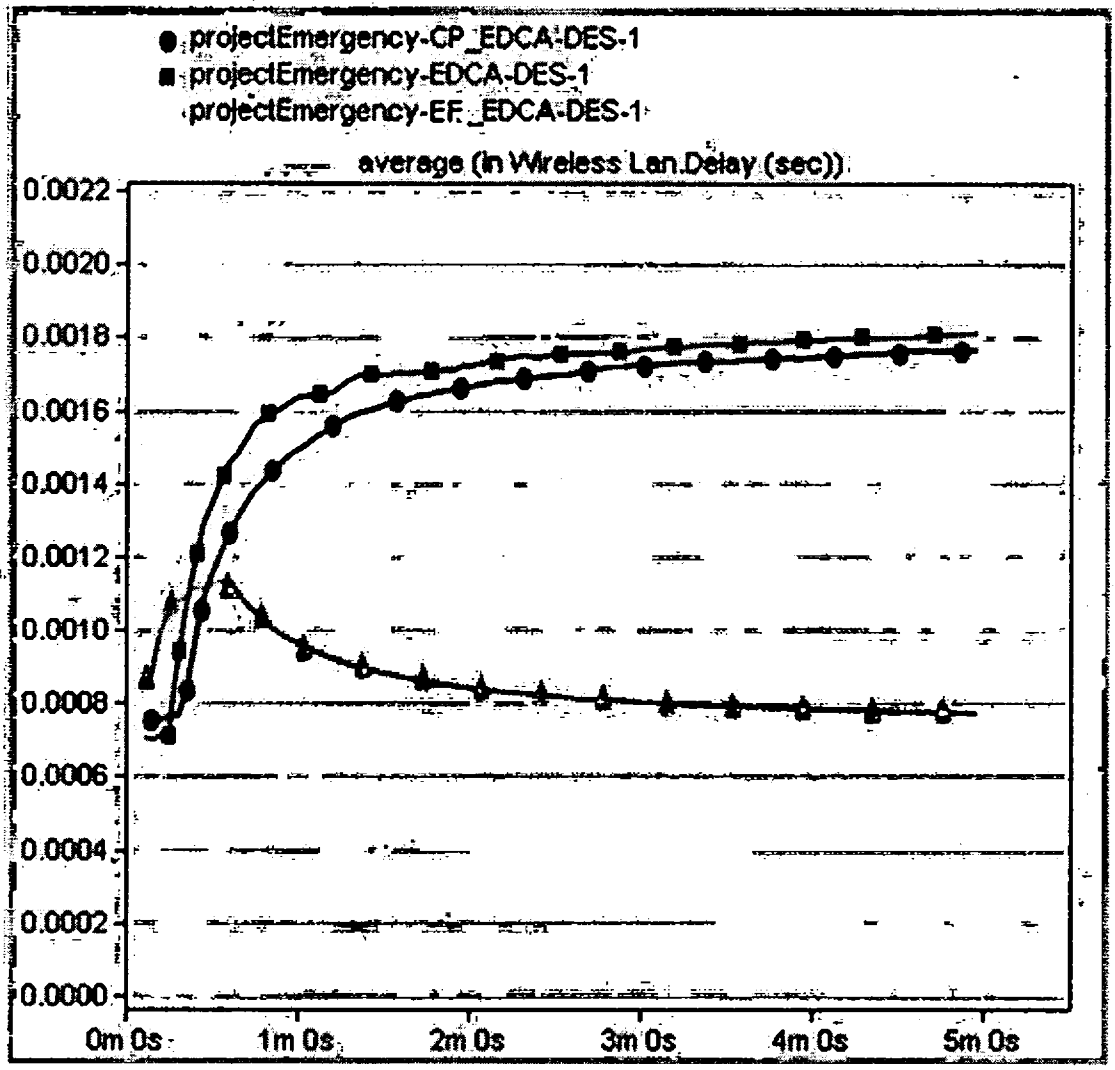
6.1 Simulation Results

In our testing, we have

6.1.1 End-to End Delays

We perform simulation on the end-to-end delay for these three CP-EDCA, EDCA and EF-EDCA scenarios, the gained results illustrate a major difference between EF-EDCA scenario and the other two

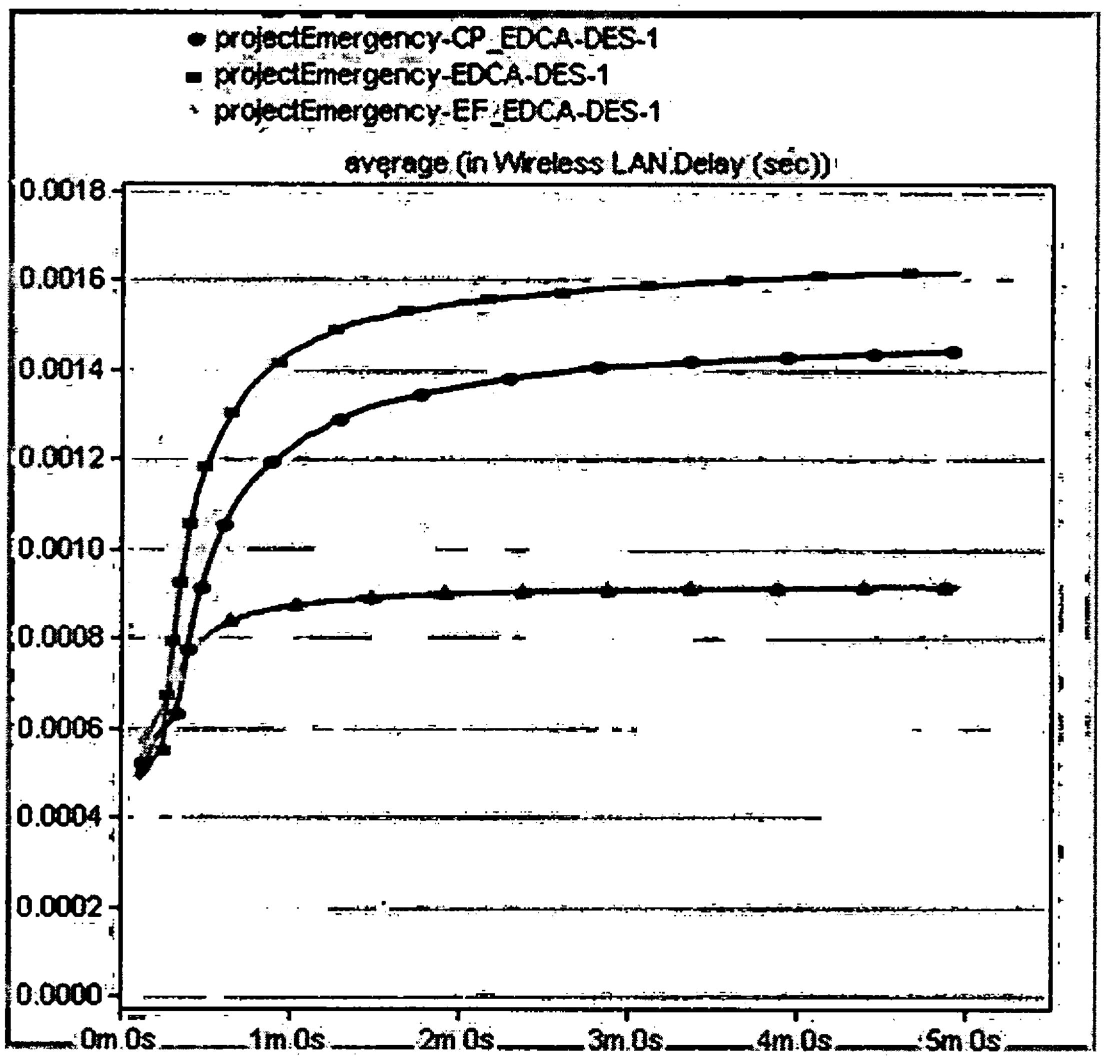
6.1.2. Overall Delays



(Vertical & Horizontal line mentions the throughput and Time in seconds respectively.)

Figure 6.1. Overall Delay.

6.1.3. Emergency Node Delays



(Vertical & Horizontal line mentions the throughput and Time in seconds respectively.)

Figure 6.2.Emergency node delays

6.1.4. Overall Retransmission Attempts Scenario

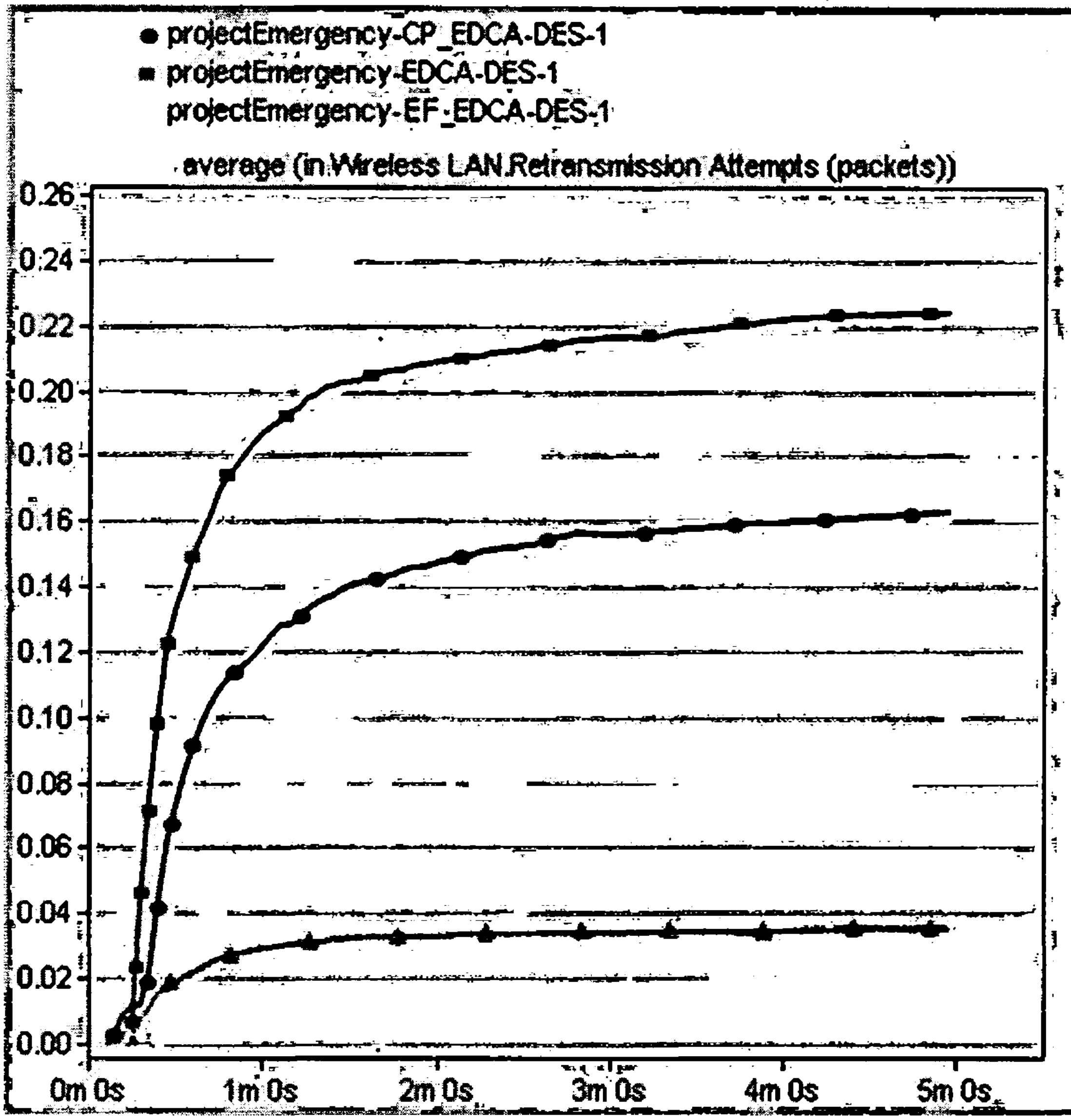


Figure 6.3. Overall Retransmission Attempts.

CHAPTER # 6

CONCLUTION AND FUTURE WORK

In this research we have introduced the Emergency Frame work (EF-EDCA) Channel Service Preemption in this use the medium access control protocol (MAC) to support a better quality of services (QoS) and it improves the performance of typical WLAN. Emergency frame work design QoS model specially for dense situations it is not enough it also develop a new MAC protocol that emergency traffic and provide strict QoS guarantee to time sensitive application with high throughput and achieve complete relative analysis.

7. Future Work

The objective our future work to design efficient mechanisms for QoS guarantee, QoS protection, bandwidth allocation, and handoff/roaming schemes for time sensitive traffic (e.g., Emergency Traffic, Voice, Video) .

1. There is need to develop a well-organized distributed admission control method for QoS guarantee of time sensitive application and distributed data control mechanisms for QoS protection of time sensitive traffic from best effort data traffic.
2. There is need to develop efficient bandwidth allocation schemes at the contention based MAC layer.
3. There is need to develop efficient handoff /roaming QoS guarantee schemes in WLAN/WLAN and third generation (3G) /WLAN integrated networks.

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