Performance Analysis of Point Coordination Function to Improve Quality of Services in IEEE 802.11

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Abstract— An improved IEEE 802.11 wireless local-area network (WLAN) is presented in this work. Wireless networks are better than the wired networks they provide a low-cost alternative to the traditional system. The IEEE 802.11 standard uses by Wireless LAN. There are basically to methods to access the medium Point coordination function (PCF) and Distributed coordination function (DCF). To improve the PCF a large work is performed and new schemes were proposed like Modified PCF, Dynamic PCF, ICF, BD-PCF, MM Scheme, etc. The PCF transmit the single packet at a time in the uplink and downlink communication. The new scheme is proposed, MoPCF scheme which checks the load of the traffic. The MoPCF scheme's behavior is decided according to the number of packet at node. The proposed TOPCF scheme increases the throughput and decreases the delay in the WLAN. So MoPCF scheme enhances the Quality of Services. Simulation results show that the improved PCF outperforms the distributed coordination function (DCF) in both the basic-access and request/clear-to-send modes in terms of the total throughput and delay. The MoPCF work well compare to the PCF.

Keywords: PCF, IEEE802.11, WLAN, MoPCF

I. INTRODUCTION

The Wireless LAN is one of the rising technology providing users with network connectivity without a wired network. WLANs supply high data transfer capacity to clients in a predefined constrained land territory. The design of WLAN is the same as Local Area Network (LAN's) aside from that the transmission happens by means of radio recurrence (RF) or Infrared (IR) and not through physical wires [1]. These remote innovations are assuming an undeniably noticeable part in the whole Internet foundation. IEEE 802.11 is most generally and quickly utilized standard now days for its effortlessness and heartiness. As remote medium is a mutual medium, so as an ever increasing number of gadgets request the data transmission, execution has turned into an essential issue of concern [2].

Wireless Local Area Network (WLAN) : The architecture of WLAN fig 1 is the same as the Local Area Network (LAN) except that the transmission performed via radio frequency (RF) or Infrared (IR) and not through physical wires/cables, and at the MAC sub-layer, it uses different standard protocol. Wireless network allows different nodes to communicate with each other wirelessly.

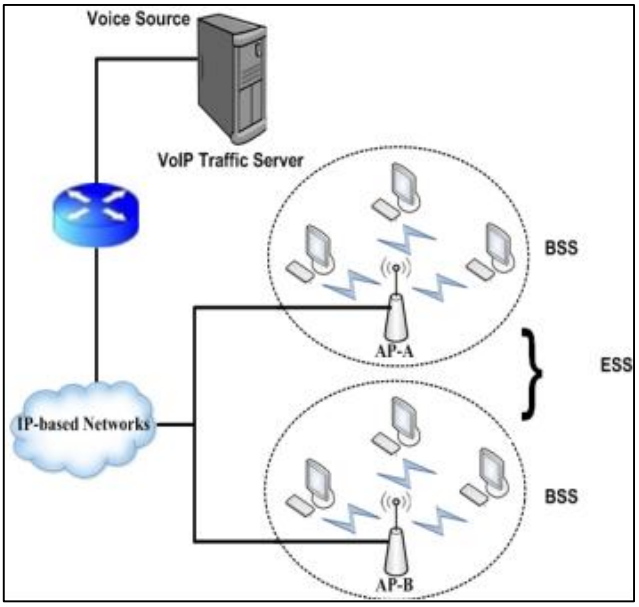

Fig. 1: Voice over WLAN [1]

WLAN gives associations with the distinctive IP systems and VoIP applications that are as of now running over IP systems. Thus, these two advances are currently converged to fuse VoIP over WLANs (VoWLAN) [3].

WLANs are a choice to the high establishment and maintaining costs caused by ordinary increments, erasures, and changes experienced in wired LAN frameworks. Remote system enables distinctive hubs to speak with each other remotely. It can be separated in two different ways [4][5] as Infrastructure mode and Infrastructure less mode.

II. RTS / CTS MECHANISM

To keep the impacts STAs conveys a Request to send (RTS) and Clear to send (CTS) edges to flag that a transmission is going to happen and discover that if the media is occupied or not. The source STA sends the RTS edge to its goal STA which restores a CTS outline back to the source. The CTS and RTS outlines serve to report to all STAs in the area of both source and recipient the up and coming casing transmission. The data got by means of these two casings tells the STAs getting them to what extent the transmission will happen and to postpone any transmissions of their own.

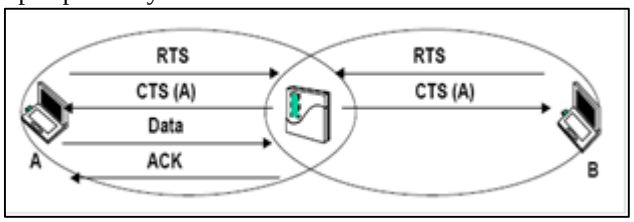

Fig. 2: Illustration of the RTS/CTS mechanism

The fig. 2 above demonstrates to us that two battling STAs needs to get hold of the channel in the meantime. A RTS outline is sent from both STA An and STA B to the AP.

The RTS gotten by the AP from STA A first and issues a CTS outline which tells all hearing STA that is permitted to utilize the channel first. This data is contained in the CTS and STA A begins transmitting with an information outline. The AP recognizes the information outline with an ACK. The RTS outline, CTS outline, the information outline, and the ACK are all piece of the same nuclear activity and take care of the shrouded hub issue. On the off chance that this casing trade is comes up short anytime, the condition of the trade and the data conveyed in every one of the edges permit the STAs that have gotten these edges to recuperate and recapture control of the medium in an insignificant measure of time. The source will retransmit a casing that has not been recognized after guidelines for planning retransmissions. At some point Monopolization done by MAC for avert it endeavours to convey a solitary casing, there are retry counters and clocks to confine the lifetime of an edge [5][6]. The RTS/CTS methodology is a required capacity of the MAC layer, yet it might be balanced by setting the RTS limit in the gadget driver or crippled. This four-way outline trade is performed for the casings bigger than the edge. Casings shorter than the edge are essentially sent [7][8].

A. Shortcomings of the RTS/CTS:

In [9][10] depicts why the RTS/CTS instrument is certainly not an ideal answer for the shrouded hub issue. Remember four STAs where STA B is allowing a CTS casing to the RTS outline sent by STA A. This edge can crash into RTS outline sent by STA D at STA C. STA D is a concealed hub from STA B. Since STA D does not get expected CTS outline from STA C, it retransmits the RTS outline. At the point when the STA A gets CTS outline, it doesn't know about the crash at STA C and continues with an information edge to STA B. This information edge will slam into the CTS outline sent by the STA C in light of STA D's RTS outline since STA B hears and gets both STA An and STA C's transmissions. Presently raise another issue situation that can happen when numerous CTS outlines are conceded to various neighbouring STAs. STA A transmits a RTS casing to STA B. At the point when the STA B is restoring a CTS outline back to STA A, STA C transmits a RTS edge to the STA D. Since STA C can't hear CTS outline sent by STA B while it is transmitting a RTS casing to STA D, STA C doesn't know about the interchanges between STA An and B. The CTS sends by STA D to STA C and since both STA An and C are conceded transmission an impact will happen when both begin sending information.

B. Exposed Node Problem:

Uncovered hub issue happens when one STA catches a transmission from neighbouring STAs. An uncovered STA is a STA in radio scope of the transmitter, however out of radio scope of the collector. In the IEEE 802.11 the detecting reach can be up to the 550 meters, will the transmission run is up to 250 meters. A STA catching a transmission ends up quiet, however could in truth be transmitting itself the other way without meddling with the effectively continuous transmission, and in this way squandering transfer speed in the WLAN. To portrays the two distinct answers for the uncovered hub issue with the utilization of discrete control and information channels or the utilization of directional reception apparatuses. In the fig. 3, we can see four STAs where the transmission from STA C to STA D is meddled on the grounds that STA C hears STA B transmission to STA A. Both transmission could be sent and got without impedance however the detecting range in the radios to STAs gets, in this case, too much data.

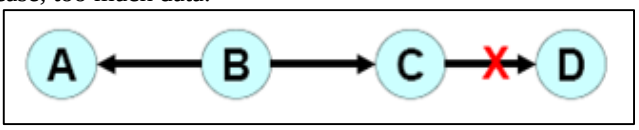

Fig. 3: Illustration of the exposed node problem

III. WIRELESS CHANNEL ACCESS METHODS

Remote LAN standard 802.11 characterizes two modes for remote channel get to. These two are disseminated coordination work (DCF) and point coordination work (PCF) [8].

A. PCF and DCF:

DCF mode depends on arbitrary access of channel that is most appropriate for non-constant movement, that is, Burstyn activity, and PCF mode depends on surveying system that is more suited for on-going activity. The majority of the WLAN gadgets don't bolster PCF mode. Amid early long periods of the DCF mode was bolstered in WLAN gadgets, however as of late, the DCF and in addition PCF mode is being perceived.

The DCF method of channel get to depend on the transporter sense different gets to with impact shirking (CSMA/CA). The planning outline of DCF conspire is appeared in Fig. 4. In the DCF get to mode, control to the entrance of channel is disseminated between every one of the stations. The DCF get to strategy depends on the CSMA/CA guideline in this a host, wishing to transmit, faculties the channel to check whether it is free or not. On finding the channel free, the host sits tight for an irregular measure of time before transmitting [11][12][13].

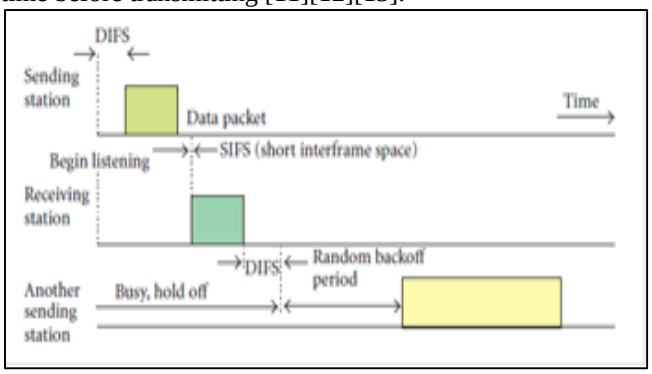

Fig. 4: DCF [6]

In the PCF method of activity, the entrance of the remote channel is brought together by a surveying based convention controlled by the essential issue called point organizer (PC). The passageway (AP) fills in as PCs. The PCF is appeared in fig. 5. The PCF mode gives dispute free support of the remote stations. In the PCF method of channel get to, an edge is partitioned in two sections: one is sans dispute period (CFP) and another is conflict period (CF). The PC indicates the beginning of the conflict free period by sending an uncommon casing called guide outline that contains the rundown of poll able stations and other surveying administration data. The CFP is rehashed after a characterized

settled interim. The CFP and CP mutually make a super edge [6].

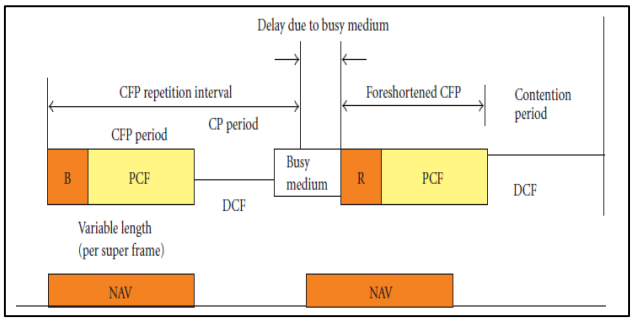

Fig. 5: PCF [6]

In the wake of transmitting the reference point, the PC begins surveying the stations one by one in the request showed in the signal edge. In CFP, if the middle point PC has an information parcel to send to a station, it sends the surveying bundle on the information bundle, and if the PC does not have information to send to station, at that point it transmits just a surveying parcel. The surveyed station presently reacts by sending the uplink ACK bundle and sends any uplink information on the ACK parcel. On the off chance that surveyed station does not have any information parcel to send in the uplink, at that point it just sends an invalid bundle in light of the survey performed by PC.

IV. OBJECTIVE

In WLAN DCF and PCF are utilized for the coordination work. The two plans are not finished. They have a few restrictions. To upgrade the essential plans, the diverse new plans were created. These are better in the throughput, less postponement, less bundle misfortune. The fundamental goals of the work are as following –

1) To examination the WLAN.
2) To examination the diverse medium access strategies.
3) Develop another medium access plan to expand the Quality of Services.
4) Prepare reproduction of proposed plot and perform tests.
5) Perform the Comparative examination of the execution of proposed plot.
6) Compare the after effects of new proposed Scheme with the current medium access conspire PCF.

V. METHODOLOGY

There are distinctive plan were proposed in the WLAN to enhance the execution. The PCF and DCF are the base medium access strategies given in the IEEE 802.11. The PCF conspire and proposed plot is examined underneath

A. IEEE 802.11 PCF:

The PCF mode is focal controlled technique that basically depends on surveying access and it furnishes association arranged administrations with a fix level of QoS. At the point when PCF works in the foundation WLAN, Access Point declares CFP reiteration interim. The CFP is trailed by CP, as appeared in the fig. 3.1. Amid the Contention Free Period, every one of the stations needs to get to the WLAN channel which utilizes the PCF technique. After this, the AP in the system and the stations go into CP interim, where DCF is executed.

CFP begins with a guide outline (B) which is frequently transmitted after the PIFS. With a signal, the AP takes the control of WLAN channel after the CP. The reference point outline contains data identified with length of both of CFP and CP that are indicated inside CF Prepetition interim and most extreme admissible span of CFP-Max-Duration. The second one is utilized to refresh the system designation vectors of the versatile stations. Both the CFP reiteration interim and the greatest reasonable term can powerfully alter by the AP as indicated by information movement necessities. The estimation of CFP-Max-Duration ought to be chosen such that it permits no less than one information parcel can be transmitted amid CP, that is required for the concurrence of dispute and conflict free activity in the super edge. CFP closes with the CFP End that is control parcel transmitted by the AP. It additionally flags the start of a CP period. CP periods are utilized by the stations in the WLAN for the transmission of information parcels and additionally re-affiliation control bundles for the stations which need to join the AP or leave the surveying list.

Fig. 6 shows the PCF get to technique. The figure comprises of three sections. On the best part, the surveying action of the AP is appeared. In the centre part, the vitality utilization is delineated. In the base segment, the Polled stations are shown.

In this illustration, a CFP interim is begun with a B outline. After the SIFS time frame, the AP consolidates a survey bundle with an information parcel (D1) and sending it to Station 1. In the wake of accepting the joined parcel, Station 1 recognizes survey and information with a consolidated bundle containing an ACK and information packet (U1) to AP. The AP sends an affirmation to Station 1, joined with a surveyed bundle with an information parcel (D2) coordinated to the Station 2. Because of the channel mistakes or an impact, there is a missing reaction from Station 2 amid a PIFS interim. The AP surveys the Station 3 with a surveyed parcel joined with an information bundle (D3). Station 3 has no information to transmit in this opening so it answers an ACK with an invalid control parcel to the AP. The CFP time frame end with the transmission of the CE bundle. The proposed TOPCF calculation is an enhanced adaptation of bi-directional PCF.

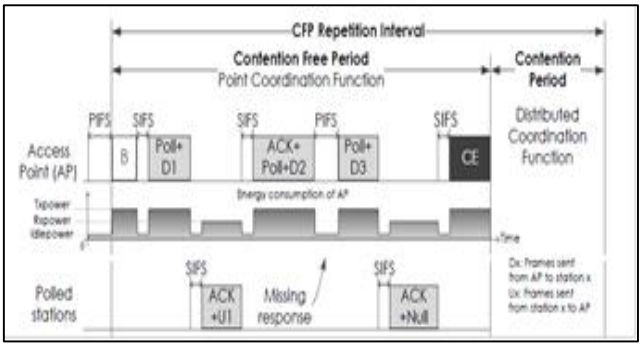

Fig. 6: Operation of IEEE 802.11 PCF.

B. Proposed Algorithm:

To conquer the downsides of the PCF plot, the Traffic Oriented PCF (TOPCF) conspire is proposed in this work. In this plan the PCF works as indicated by the Traffic stack in the system.

With the start of the bidirectional transmissions, the induction to the WLAN divert for a station in the surveying rundown to be endorsed for one SIFS interim in the wake of getting the information parcel from the AP. The surveyed station at that point recognizes the reaction of the information parcel by sending a voice bundle to the AP. Presently if the station has the in excess of five parcels to send than three bundles are transmitted in one space, else one bundle is transmitted. By sending two bundles, the station can send more information in less time to the AP. On the off chance that the surveyed station has no information to transmit in remote system then it just recognizes (ACK) the voice parcel, or sends answer with the invalid bundle whether the AP sent survey parcel on account of no information for the station. So the surveying overhead of the system can be limited when the AP has downlink information for the stations of WLAN in the surveying list.

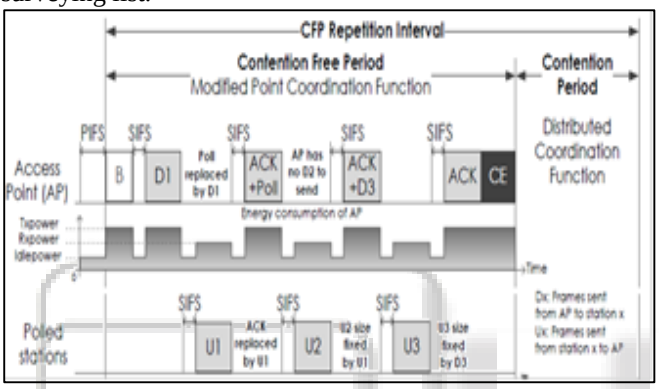

Fig. 7: Traffic Oriented PCF (TOPCF)

The improvement which is done in the work is that in every time slot assigned to AP, it sends three packets in downlink packet to the stations when it has more than five packets otherwise it transmit only one packet. The slots are separated by the SIFS. The same happens in uplink traffic the station after getting time slot for transmission, the station sends three packets in one time slot to the AP in case when more than five packets at station otherwise one packet by station. The D1, D2, D3 etc. has the data packet either three packets or one packet depending on the total packet present at the AP and stations. The criteria of six packets or more is taken, which reduces the number of cycles for sending uplink and downlink data.

C. System Architecture:

In the proposed system the IEEE 802.11b WLAN is used. In two types of WLAN, infrastructure WLAN is considered. There are n numbers of stations that are connected to the AP. The stations store the packets in the buffer. Within a BSS there are two streams- one is uplink from voice generating station to the Access Point and another one is the Downlink from AP to the station.

D. Super frame Architecture:

The super frame is the combination of the two parts - contention free period (CFP) and the contention period (CP). The start of contention free period is indicated by sending beacon frame that contains the list of poll able stations and other polling management information. The real time voice data is send through the CFP. The range of CFP is taken 15-19ms. The value of CP is at least one ms.

E. Experimental Setup:

The simulation scenario of the proposed scheme experiment considers a single WLAN in which one AP and a number of associated stations which varies from 5 to 50. All stations lies in the transmission range of AP.

F. Parameter List:

The following parameters are used in the simulation of Traffic Oriented PCF (TOPCF)

Parameter	Value
SIFS	10 µsec
Beacon	20 bytes
Poll	20 bytes
CF-End	20 bytes
Null Packet size	240 bytes
Data packet	1500 bytes
Data rate	48 Mbps
ACK	14 bytes
CFP interval	18 ms
PIFS	19 µsec
Number of Packet	1-10
Number of Nodes	5-50
Simulation Area	500m X 500m

Table 1: IEEE 802.11 Parameters and Values

G. Assumptions:

The following assumptions are used in the simulation of the Traffic Oriented PCF (TOPCF) :

- All the nodes are in the coverage area of the AP.
- The entire nodes are in active mode.
- There is no power saving mode is applicable.
- It is assumed that the channel is assumed to be error free.
- The PCF working in CFP is only taken, no CP is considered.

VI. RESULTS

The PCF and Traffic Oriented PCF are implemented and experiment is performed. The following results are obtained.

A. PCF Scheme:

The results are obtained for the nodes in the WLAN from 5 to 50. The delay and throughput for the nodes is shown in the table 1 and 2. From the table 1, it is clear that the increase in the node decreases the delay in the network. For 5 nodes the delay is 2861 µs while when the nodes are 50 then delay become 1158 µs.

From the table 2, it is clear that the throughput decreases with increase in the number of nodes. For 5 nodes throughput is 71.43% while for the 50 nodes the throughput is 31.65%.

B. Traffic Oriented PCF:

The results are obtained for the nodes in the WLAN from 5 to 50 for Traffic Oriented PCF. The delay for the nodes is shown in the table 4.3. From the table 3, it is clear that the increase in the node decreases the delay in the network. For 5 nodes the delay is 2450 µs while when the nodes are 50 then delay becomes 599 µs.

No. of Node	Delay
5	2861
10	2620
15	2652
20	2445
25	2316
30	2232
35	1716
40	1453
45	1261
50	1158

Table 2: Delay for PCF

No. of Node	Throughput
5	71.43
10	67.18
15	61.34
20	65.68
25	52.51
30	36.96
35	35.27
40	398
45	34.26
50	31.65

Table 3: Throughput for PCF

No. of Node	Delay
5	2450
10	2531
15	2369
20	2288
25	1839
30	1434
35	1130
40	1046
45	611
50	599

Table 4: Delay for Traffic Oriented PCF

The throughput for the nodes is shown in the table 4.From the table 4, it is clear that the throughput decreases with increase in the number of nodes. For 5 nodes throughput is 91.67% while for the 50 nodes the throughput is 34.75%.The Traffic Oriented PCF throughput graph is shown in the fig 4.4.

No. of Node	Throughput
5	91.67
10	883
15	70.32
20	67.01
25	61.57
30	489
35	41.14
40	50.42
45	34.41
50	34.75

Table 5: Throughput for Traffic Oriented PCF

C. Comparative analysis of PCF and proposed TOPCF

1) Delay:

In the table 4.5 the delay for the PCF and Traffic Oriented PCF is given. There is decrement in the delay in the proposed technique that the existing PCF.

In fig. 5, the comparative delay graph is shown for the PCF and Traffic Oriented PCF. From the graph it is visible that the delay for TOPCF is less than the delay for PCF for nodes in the WLAN. This decrement is due to transmitting three packets simultaneously in the uplink and downlink traffic.

There is large difference in the delay for the 50 nodes. For PCF it is 1158 µs while for TOPCF it is 599 µs, which is approximately 50% reduction in the delay. TOPCF gives the better result than the PCF.

No. of Node	Delay for PCF	Delay for TOPCF
5	2861	2450
10	2620	2531
15	2652	2369
20	2445	2288
25	2316	1839
30	2232	1434
35	1716	1130
40	1453	1046
45	1261	611
50	1158	599

Table 5: Comparative Delay for PCF and TOPCF

2) Throughput:

In the table 6 the throughput for the PCF and Traffic Oriented PCF is given. There is decrement in the delay in the proposed technique that the existing PCF.

No. of Node	Throughput for PCF	Throughput for TOPCF
5	71.43	91.67
10	67.18	883
15	61.34	70.32
20	65.68	67.01
25	52.51	61.57
30	36.96	489
35	35.27	41.14
40	398	50.42
45	34.26	34.41
50	31.65	34.75

Table 6: Comparative Throughput for PCF and To PCF

In fig. 4.6, the comparative throughput graph is shown for the PCF and the proposed Traffic Oriented PCF. From the graph it is visible that the throughput for TOPCF is more than the throughput for PCF for nodes in the WLAN. This increment is due to transmitting three packets simultaneously in the uplink and downlink traffic when the load of traffic is high.

There is large difference in the throughput for the 50 nodes. For PCF it is 31.65%while for TOPCF it is 34.75 %which is higher than PCF. TOPCF also gives the better result than the PCF for 5 nodes.

In overall the Traffic Oriented PCF gives the better results than the PCF in both the criteria i.e. delay and throughput. So the Quality of Services of the WLAN increases.

VII. CONCLUSION AND FUTURE SCOPE

The fast growing number of the wireless users has increased the value of WLAN. The demand of WLAN oriented users is increasing day by day. A lot work is performed to enhance the quality of services of WLAN. The QoS is increasing day by day due to the lot of research work in the WLAN.

This research work has provided very important theoretical and experimental evidence in the performance modelling and enhancement of IEEE 802.11 PCF. The research work involved three main tasks. The first task was focused on the performance evaluation model of IEEE 802.11 PCF, and the second task was to propose a new algorithm for WLAN to reduce the MAC layer packet delay. Finally, the third task was to enhance the system performance of IEEE 802.11WLAN in terms of throughput and delay.

In this work the Traffic Oriented PCF is proposed to overcome the limitations of PCF. The PCF transmit the single packet at a time in the uplink and downlink communication. The proposed TOPCF scheme checks the load of the traffic. If the station / AP have more than 5 packets than three packets are transmitted otherwise single packet is transmitted. The double behaviour is used according to the number of packet at node.

The main achievements in this research work are summarised as follows:

- A new Traffic Oriented PCF has been developed for packet transmission in IEEE 802.11 WLAN under different traffic load conditions.
- The developed model has been used to evaluate the system throughput of IEEE 802.11 WLAN under different traffic load conditions. The proposed TOPCF scheme increases the throughput. PCF gives 31.65 % throughput for the 50 nodes while for TOPCF it is 34.75 % which is higher than PCF. The throughput results have highlighted the importance of new approach. The collision probability decreased. The accuracy of the proposed model is validated through the extensive increase in the throughput..
- The proposed Traffic Oriented PCF model accurately estimating the MAC layer packet delay for IEEE 802.11 WLAN. For PCF delay is 1158 µs while for TOPCF it is 599 µs for 50 nodes which is approximately 50% reduction in the delay. The results have demonstrated that the developed model has presented a good approach with IEEE 802.11 WLAN.
- The TOPCF gives the better results than the PCF. So Traffic Oriented PCF able to improve the Quality of Services.

The simulation experiments and validation of the above proposed models and algorithm have been carried out using MATLAB. In addition, Maple has been used to undertake calculation of certain equations such as polynomial equations and exponential equations.

In the future work the performance modelling and the analysis of IEEE 802.11 WLAN have presented very important theoretical and practical works in the design and enhancement of WLANs. Based on analytical modelling development, this research work has given new algorithm. The following are considered to investigate and propose new algorithm:-

- Traffic loads
- The voice packets of traffic
- Packet delay analysis.
- Throughput analysis
- Comparison with PCF
- The QoS for real time application in WLANs.

The hidden station problem is not taken in to account. There are sleep mode of the node is not considered. These may be considered in future, which can further improve the quality of the services.

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