Highly Optimized Performance in HCCA 802.11e Mechanism for Safety Critical Real Time System

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Abstract*: Wireless local area network is emerging field in research and science. It is all about the transmission of data through various networks. The common categories of data transmission are email, twitter and web browsers. These days, the WLAN are being capable to support various time sensitive services like voice and videos. Most of the applications of WLAN are seen in hospitals, at airports and in huge commercial areas. Further, WLAN is not just support to Ethernet but also applicable for providing better quality of services (QoS). The local network is more flexible, scalable and mobility of nodes does not create traffic on network. There is use of some routing protocols that improves the working criteria of WLAN. The routing protocols are EDCF (Enhanced Distributed Coordination Function), HCF (Hybrid Coordination Function), DCF (Distributed Coordination Function) and PCF (Point Coordination Function). Firstly of all, the study of 802.11 is required before moving on the routing protocols. It is discussing about the shortcomings of QoS of a network and performed two types of operations as DCF and PCF. In this research work, the chief focus is on the EDCA, HDCA and BFOA (Bacterial Foraging Optimization Algorithm) which is inspired from the behavior of enzymes as name Escherichia Coli and utilized with the use of Chemo-taxis. In this work, a new optimized HCCA 802.11E is discovered mainly for the safety and real time systems under the Wireless local area networks. In research work, we will perform the optimized (BFOA) service intervals and TXOP calculations in hard real time scheduling scenario. Then it will evaluate the performance of the system in terms of end delay, throughput and packet losses in hard real times and evaluates the performance with the base approach. The results are generated from proposed work demonstrates that the packet loss and end to end delay declined dramatically while throughput is continuously flourished.

***Index Terms*: WLAN, TXOP, EDCA, HCF and BFOA algorithm.**

I. INTRODUCTION

WLAN can give easy and convenient, smooth deployment solutions and has been useful in several industry areas. In safety RTS (Real-Time System) attribute which is known as HRT messages. In this messages will lead to great harm of property and loss like as the crash of COLUMBIA-SPACE SHUTTLE and the disappointment of AMERICAN ALEONNA V ROCKER LAUNCH, when their goals or limits are missed. As a consequence, the WLAN application in these fields has to re-solve the data transmission of HRT communications i.e, strictly ensure the QoS of HRT[1]. For IEEE 802.11e can offer the normal Wireless Local Area Network guarantee. In IEEE standard algorithms, HCF function managed channel access sample schedule implements the concept of data transmission opportunity which cares the priority of quality-of-services. Various references have described, how to reduce the sample schedule to support the Quality-of-Service of messages better. It defines the TR (Token Rate) and BS (Bucket Size) according to the time bound parameter in TS (*Traffic Specifications) [2] and approximation the number_of_TXOP of the WS (Work Station) during individual service interval by using the memory Size parameter. It prefers quality-of-service of RTMs by dynamically modifying the length of SI. It calculates the TXOP in the next-phase by using the LPS (Left Packet Size) of each site to get better services. Several multi-media applications such as online gaming, HD TV and VOIP etc is an significant challenge in the WLAN. IEEE standards absences the support of QoS as requested by multi-media applications , for illustration, in terms of surity bandwidth and time , jitter and PL (Packet Loss)[3]. IEEE was designed for best effort information transmissions. Later, the standard amendant has been shaped to give Quality of service support. Various services are introduced, as per requirement by multi-media apps. Service differentiation is possible recognition to twice novel MAC methods that enhance the methods prioring in IEEE standards. HCCA includes a performance metrics in quality services at the polling structure, where as EDCA provisions prioritized quality of service at the content base MA. Moreover, several simulation studies and theoretical high-lighted that the reference scheduler has good-performance only with CBR (Constant Bit Rate) traffic, where as it's not suitable to give tempora guarantees to VBR traffic[4]. Several scheduling methods have been implement as an alterative to the reference one in order to reduce its poor-performance, due to the fixed values the HCCA method assign and optimize the performance assigns to the transmission metrics [5]. In this research work, we present a new scheduler with optimization named HCCA and BFOA algorithm which designs a mechanism for bandwidth regaining into a HCCA (Real time Scheduler)RTS. The structure assigns the section of TXOP un-used by polled Stations to the next scheduler TS (Traffic Stream). After HCCA algorithm introduced a BFOA algorithm to refilter the output with the basis of Elimination, dispersal and reproduction. It calculate the performance metrics like as a Delay, Throughput and HRT Packet Loss. The research paper is pre-arranged as follow:- In section II we described as a IEEE standards and types.

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In section III, the summarized a various research work in WLAN with HCCA safety real time system. In section IV. Sumjmarized the scheduler algorithm in HCCA method and Section V. explained the proposed work with BFOA algorithm. Section VI. Discussed the results and simulation tool. Section VII conclude the research work done and future work in WLAN.

II. BACKGROUND

The specifications of the media access control (MAC) and Physical (PHY) layer for wireless LAN. The physical layer specifications based on frequency, hopping spread spectrum compared to normal data rate ranges up to 2 mbps. The several specifications presently in use are 802.11a (IEEE 802.11a, 1999), 802.11b (IEEE 802.11b, 1999) and 802.11g (IEEE 802.11g, 2003). 802.11a supporting a data rate up to 54 Mbps and 802.11b and 802.11g physical layers functions up to 54 Mbps [6]. The IEEE 802.11 protocol describes architectures of WLAN which are independent service set and basic service set. The wireless station related to access points and the communication take place in access points. The independent service station communicates with each other at the transmission range. Such type of the architecture forms a wireless ad hoc network in the absence of the network organisation[7]. The IEEE 802.11 protocol describes two mechanisms which are Distributed Coordination Function (DCF) and the Point Coordination Function (PCF) in MAC layer. The mechanism provides distribution network based on the Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). The data frames transmits to sense the network is busy or idle . After sensing the network, the channel duration is equivalent to Distributed Interframe Space (DIFS) time. The collision may occur in the network, so in order to avoid the collision back-off procedure at the node [8]. When the back-off procedure starts at random timer, then the value of interval decremented at each slot time. After the sensing processing .the channel becomes busy the station pauses its back-off timer until the channel is free again. The next timer expires during the next transmission. At the first attempt , the CW sets at minimum Contention Window size . The Contention Window size increased after each transmission.

$$CW_{new} = 2 \text{ x } C\,W_{old} + 1,$$

The equation reached up the maximum Contention Window size. At each transmission rate the value of Contention Window value is reset to minimum value. The PCF mechanism splits time in super frames and the channel access within contention free period. The PCF is time bounded service whereas DCF designed to support the traffic rates. The supporting of the periodic time is difficult in CFP. The duration of the polled value is unidentified in PCF. The extensions of the MAC layer protocol provided by IEEE 802.11e specifications maintains the time constrained applications[9].

III. RELATED WORK

Li, J., Yuan, K., Zhou et al., 2017[10]studied on security mechanisms in WLAN.In this pseudo code was designed on the basis of the security of the wireless sensor networks.In detection of the wireless networks can be secured by analysing MAC frames in WLAN. The limitations are that different format of frames. The frames of wireless network were encrypted,related to security mechanisms.The security mechanism reduced for the detection of the security algorithms.**Refaat, T. M Abdelhamid et al 2016[11]**proposed a research on security solutions for wireless local area networks. The problems in the security of the networks weredue the broadcasting of wireless media. The main goal was to secure the data in wireless LAN. The network stability and low cost combines to achieve the security requirements of the network. In this paper, the security of network based on different that was frame security and radio frequency security. The high level security maintained by 802.11 authentications,WPA/WPA2 encryption,AES. **Willig, A., Matheus, K et al 2017[12]**analysed to meet the requirement of reliability and accuracy of the system. The intruders access the information may destroy the data and any service authorised users. Once intruders attacks the system the information transmitted between the two wireless devices can be intercepted .so data must be scored by strong encryption. The wireless technologies, organizations decrease the risk of threats and the measures include management, technical and operational to prevent the system. The main objective of this paper was to minimise the access points for the redundant systems and decrease the average location error. **Surabhi Surendra Tambe et al.,2015[13]** discussed regarding emerging technology of Wireless Brodband networks. In this paper, they focused on the standard tools and various problems associated with the implementation of these WLANs of the wireless networks. The wide band of frequencies transmits a wide range of information in the Wireless broadband technology. The wireless technologies are created to decrease the complexity and time take place in the networks. **Sachin Gorade, Rambabu Vatti et al., 2018[14]**analysed a research on the optimization of the WiFi signal strength and measurements on public WLANs. In this paper, the networks of the railway station ofPune were conducted by experiments of various factors on the strength of the Wi-Fi signal and on the download and upload speed of the WLAN had been analysed. Mainly the wi-fi signal strength depends on its distance from the route rand the connectivity, performance and general traffic patterns of a wireless network by using tool WiFi Monitor.

IV. HCCA SCHEDULING ALGORITHM

The IEEE 802.11e standard describes other referenceHCCA scheduler and the guidelines for the calculation of protocolparameters by taking into account QOS Station(QSTAs) requirements. The reference scheduler calculates the interval of service and transmission opportunities. The interval of service is calculated as single value for QOS station. The QOS
Goal is to meet the service needs and the value should be less than beacon interval. So, during each interval each value is less than the minimum value. Maximum Service Interval (MSI), the polling period of all traffic streams. TXOP calculates the minimum physical rate at maximum time[15].

$$\text{TXOP} = \max\left(\frac{N_{j\,M_i}}{T_J}\right) + o,$$

Where $M_i$is the maximum size of service interval.
If there is existence of new data stream, a new *Traffic Stream* (TS).

SI and *TXOP* are calculated again. Their values are based on poorest caseconditions, The control test and a not-optimal resource management produced by this technique. Additionally, since *SI* is the similar of all admitted QSTASs and *TXOP* is globally assigned to a QSTA, all different TSs are polled with the same period and perform with the same computation time. This makes the reference scheduler suitable to serve CBR traffic but unable to efficiently adapt the resource management to VBR[16]. The Feedback Based Dynamic Scheduler(FBDS) deals on a closed loop feedback control for restoring the balance of the right packets queue distribution by bandwidth. TXOP allocate line length at the starting of the control access phase. The approach of the network in HCCA and EDCA increases the medium utilization of large WLAN. The commercial approach used to manage the traffic over EDCA and HCCA functions affects the network congestion and throughput. The peak value of the HCCA-EDCA ratio is found by optimization methods.

The Adaptively Tuned HCF (AT-HCF) algorithm recognise the different types of traffic in [17] HCCA and the EDCA improve the throughput of the overall system. The EDCA bandwidth integrates the HCCA to edge the delay in the traffic systems. The network performance is improved by the network polling time.The high traffic exceeds the high transmission time from HCCA line to higher priority EDCA queue. The central HCCA scheduling algorithm manages the switching, arrangement of the polling list. The Scheduling Estimated Transmission Time - Earliest Due Date (SETT-EDD) Algorithm use time units to differ *TXOP* over time in accordance to need of node . The service interval of each node evaluates the traffic rate whereas Earliest Deadline First(EDF) increases the flexibility and reduces the packet loss and delay of transmission of data. The time based scheduler calculates the rate of transmission aims to schedule the downlink and uplink nodes and the traffic schedule according to EDF algorithm.[18] The Real-Time HCCA(RTH) scheduler achieves TXOP as main part where there is flow of high rate data cannot beinterrupted by higher priority. The EDF based algorithm consists of two approaches computes transmission parameters and scheduling timetable, and the online one schedules traffic streams transmission [19].Adaptive Resource Reservation over WLANs (ARROW) calculates the different buffered TXOP at beginning of the polling. The MSI confirms the requirements of the delay in the network. The Earliest Due Date (EDD) manages the QSTAs list during the polling time. The Application-Aware Adaptive HCCA Scheduler is subpart of the ARROW which differs the uplink and downlink. In uplink scheduler, QSTA is minimum and service of interval is high to the network conditions[20].

V. IMPLEMENTATION WORK

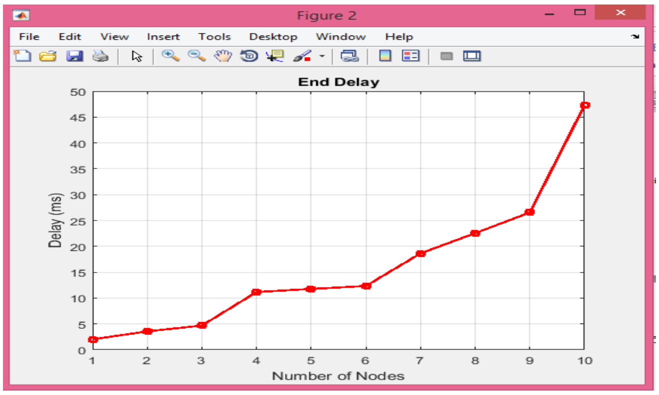
A procedure of channel access is grounded on a multiplexing process, which allows numerous data sources or signals to segment the same communication station or physical sources. In this arena, multiplexing is done using physical layer. This procedure is also grounded on a multiple access procedure and control scenarios, which is well known by media access control which deals with the issues like addressing, transmission multiplex stations to dissimilar users, and avoiding smashes. Media access control deals with the sub-layer in data link layer based OSI prototype and a module of the connection layer which is based on TCP/IP data model. The arrangement is based on the frequency-division multiplexing arrangement, which delivers dissimilar frequency bands to diverse data-streams. In this case, the data sources are allocated to dissimilar nodes or strategies. Instances of such systems were cell-phone systems, in which each phone call was allocated to a precise uplink frequency station, and additional downlink frequency station. Each message data is modulated on a precise carrier occurrence. A related method is based on wavelength-division multiplexing where dissimilar data sources get diverse colors in optical communications.A hard real-time system is one of the main constraints on HCCA systems which are software that must function within the limitations of a severe deadline. The submission may be measured to have unsuccessful if it is not comprehensive and is not completed its function inside the selected time span. So, the proposed work using BFOA (Bacteria Foraging Optimization Technique) deals with the reliability factor which will increase the bandwidth of the system and decreases the error rate which will decrease the chances of packet drop probabilities and will able to achieve high throughput, less bit errors and low packet losses.

Detailed in proposed work

1. Firstly, we will initialize the specifications like mean data rate, maximum data rates, burst times as given in the reference paper.
2. Then we will perform the deployment of nodes, access points, quality stations for the transmission of packets.
3. Then we will perform the optimized (BFOA) service intervals and TXOP calculations in hard real time scheduling scenario.
4. Then we will evaluate the performance of the system in terms of end delay, throughput and packet losses in hard real times and evaluates the performance with the base approach.

VI. RESULT & DISCUSSION

In this section, we discussed the results in the proposed work with bacteria foraging Optimization approach to enhance the energy efficiency, throughput and reduce the End to end delay.



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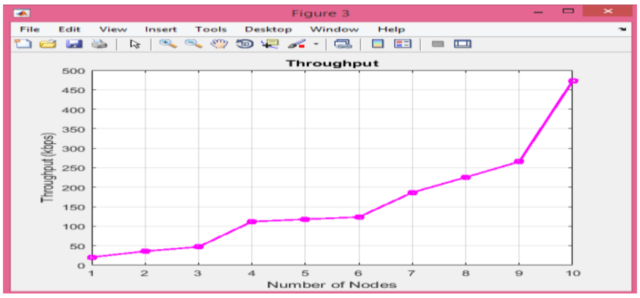

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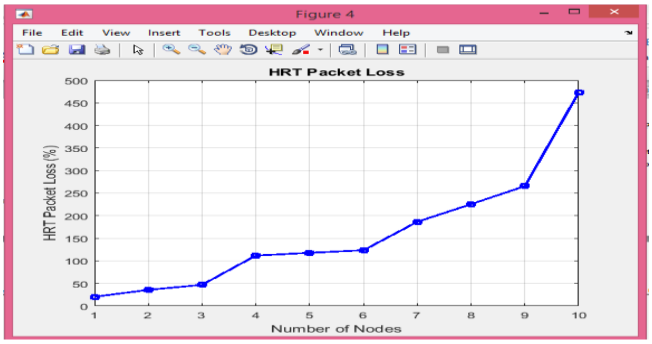
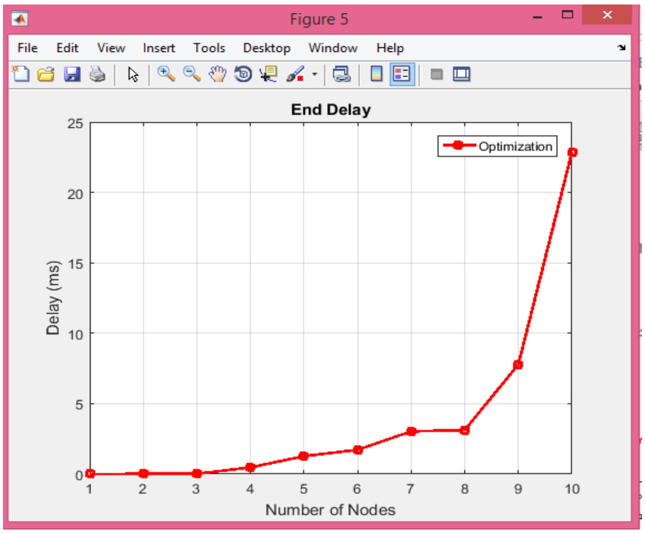


(iii)

Fig 1 (i) End Delay in scheduling (ii) Throughput in scheduling and (iii) HRT Packet Loss in scheduling

The above figure 1(i) shows the end to end delay in hard real time scheduling process without introducing reliability factor and shows that the end to end delay is 45 mili seconds with respect to the number of nodes. The above figure 1(ii) shows the throughput in bits per second in hard real time scheduling process which shows the successful transmission of the requests and the packets. The throughput must be high for the high efficiency of the system.The above figure 1(iii) shows the packet loss percentage in hard real time scheduling which shows that the 45 percent packets losses are performed by the quality access points and quality stations.



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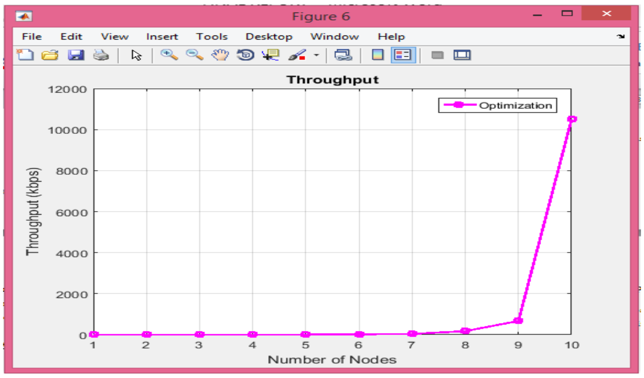

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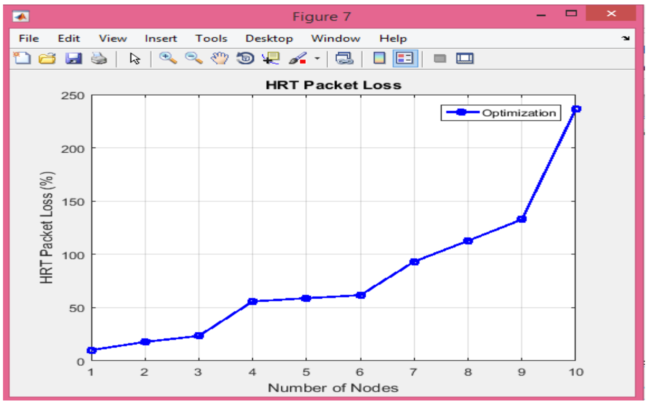

(iii)

Fig. 2. Delay in Proposed (Reliable Factor) using optimization (BFOA)

The above figure 2(i) shows the end to end delay in communication between the quality service stations, access points and number of nodes which shows the time period that how much packets are transferred with less time intervals using BFOA method. So our proposed approach is able to achieve less end delay which must be less for high efficiency.The above figure 2(ii) shows the proposed throughput in bits per second in hard real time scheduling process using BFOA optimization approach which shows the successful transmission of the requests and the packets. The proposed throughput is high for the high efficiency of the system for the successful packet deliveries. Fig 2(iii) HRT Packet loss in proposed Work using BFO algorithm for the low bit rates and shows that our proposed approach using BFO algorithm is able to achieve less packet losses than the base approach which must be low for the less bit error rates.

Table i. Comparison between proposed and existing work (scheduling (hcca) and proposed algorithm

Parameters	Base	Proposed
End Delay	47 ms	24 ms
HRT packet loss	450 %ge	222 %ge
Throughput	457 Kbps	10001 Kbps

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Table 1. shows the hard real end delay comparison between the base approach and proposed approach and shows that the proposed system is having less error rates than the base approach. The throughput comparison between the base approach and proposed approach and shows that the proposed system is having high throughputs than the base approach. The above figure shows the hard real time packet losses comparison between the base approach and proposed approach and shows that the proposed system is having low bit error rates than the base approach.

VII. CONCLUSION & FUTURE SCOPE

WLAN is wireless networks that used for countless applications which are more flexible, cost effective and implemented easily to access internet. As Usually, IEEE802.11 is considered as the vast member of WLAN and a dynamic tool. The developed WLAN is secure form various kinds of attacks such as denial of service, eavesdropping, Sybil and so much other online sniffers. Although there is some vulnerability to overcome all these weaknesses mostly HRT (Hard Real Time) messages faced a huge loss. A related method is based on wavelength-division multiplexing where dissimilar data sources get diverse colors in optical communications. Finally, by using the simulative method, it turns out that the read-time packet loss rate can be effectively reduced and QoS of HRT TS can get maximum insurance. A hard real-time system is one of the main constraints in HCCA systems which are software that must function within the limitations of a severe deadline. The submission may be measured to have unsuccessful if it is not comprehensive and is not completed its function inside the selected time span's. The research work, implemented WLAN enhanced the QoS of HRT. The main objectives of proposed work are related to the optimization of HCCA and improvement over the performance parameters such as Throughput, End to End Delay and Packet loss. The outcome of research work demonstrates that throughput inclined rapidly while End to End Delay and Packet Losses continuously fell down.In the future, the demand of WLAN is growing rapidly. So the new developments also introduced from enhanced wireless local network criteria. In fortune, the research focused to alleviate the chances of risk related to security, searching for new approaches that easily detect sniffers and improve the security of systems. Moreover, WLAN moves toward maturity in extreme speed, enhanced privacy, control over errors and also utilized for global networking. It is predicted that WLAN preferred more in resource allocation, interface management, mitigation and particularly in energy efficient routing and multi hop as compared to other wireless networks. However, there is need of more research related to the advancement of local networks.

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