An Efficient Reliable Approach for Low Packet Losses in HRT (Hard Real Time)

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Abstract –This paper aims to use WLAN protocol to support the transmission of hard-real-time (HRT) traffic stream (TS) in safety critical real time system (SCRTS). Firstly, this paper analyses the reference scheduling mechanism for IEEE 802.11e. 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. 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. The proposed work 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.

Keywords – WLAN Protocol, SCRTs, OSI Layer, HCCA systems and MAC (Media Access Control).

I. INTRODUCTION

The IEEE 802.11 standard came into existence to offer wireless local area networks (WLANs) within various environments, for example, public networks and enterprise networks. In recent years, there has been enormous growth in the popularity of wireless services and applications. In order to withstand such growth, standardization organizations such as the Institute of Electrical and Electronics Engineers (IEEE) have decided to standardize the features by providing increased Quality of Service (QoS) and higher throughputs for IEEE 802.11[1]. The Block Acknowledgment (ACK) policy feature is one of the extensions, which was included in the ratified IEEE 802.11e amendment. Different technologies of IEEE 802.11, namely, IEEE 802.11a, IEEE 802.11b, and IEEE 802.11g offer error free performance and as such they have been made the choice for WLANs and MANETs. Currently, the IEEE 802.11 family of standards is most often being used to deploy MANETs. However, the media access control (MAC) layer provided by these standards was designed for cooperation. Nodes contend for the medium using a distributed mechanism, which assumes that all participants behave properly. In a wireless network, simultaneous packet transmissions by nearby nodes may cause collisions, resulting in packet loss in 802.11 broadcast messages. This is because the 802.11 protocol cannot detect collisions, does not send acknowledgment messages (acks), and does not utilize the RTS/CTS collision avoidance mechanism for broadcast messages [2]. A node has no knowledge of the delivery report of the broadcast message it sent to the other nodes .IEEE 802.11e was proposed to complement IEEE 802.11 MAC with the purpose of offering service differentiation in WLAN. The 802.11e draft brings out the Hybrid Coordination Function (HCF) that defines two new MAC methods. They are HCF controlled channel access (HCCA) and enhanced distributed channel access (EDCA), in order to substitute point coordination function (PCF) and DCF modes in 802.11. EDCA is a distributed channel access method which can be used in ad hoc networks and provides QoS by delivering traffic based on differentiating user priorities. EDCA brings in four new priority queues, one for every access category and thus achieving service differentiation. By employing different parameter sets each priority queue has its own back off entity. There has been alarming interest to support QoS in MANETs. The integration of devices with multimedia and wireless networking facilities has made way for omnipresent audio-visual communication among peers. In order to support this need, the IEEE 802.11e working group is enhancing the IEEE 802.11 standard to offer QoS at the MAC level. We need to design a new efficient scheduling algorithm which achieves excellent throughput and fairness performance. Compared to the existing algorithms, it should produce less delay. The system should utilize the characteristic of the traffic stream and provide services [3].

To solve the drawback of the simple scheduling algorithm and so-like ones, this paper advances an improved algorithm in this paper. The algorithm defines the real-time attribute of Traffic Stream (TS), so as to distinguish real-time messages and non-real-time messages. And this algorithm uses different calculation method of TXOP for real-time messages and non-real-time messages. In addition, this algorithm can dynamically adjust the TXOP queue to achieve real-time message priority strategy, so as to provide maximize QoS guarantee of real time TS[4].

The HCCA is an extension of the Point Coordination Function (PCF) protocol. HCCA controls the WLAN through a module called Hybrid Coordinator (HC). Explicit access is given to the real time flows by HCCA during the Contention Period (CP). HCCA requires a centralized QoS-aware coordinator, called HC, which has a higher priority than normal QoS-aware stations (QSTAs) in gaining channel control. HC can gain control of the channel after sensing the medium idle for a PCF inter-frame space that is shorter than DCF inter-frame space adopted by QSTAs. After gaining control of the transmission medium, HC polls QSTAs according to its polling list. In order to be included in HC's polling list, a QSTA needs to negotiate with HC by sending the add traffic stream frame. In this frame, the QSTA describes the traffic characteristics and the QoS requirements in the traffic specification (TSPEC) field[5]. Based on the traffic characteristics and the QoS requirements, HC calculates the scheduled service interval (SI) and transmission opportunity (TXOP) duration for each admitted flow. Upon receiving a poll, the polled QSTA either responds with QoS-data if it has packets to send or a QoS-null frame otherwise. When the TXOP duration of some QSTA ends, HC gains the control of channel again and either sends a QoS-poll to the next station on its polling list or releases the medium if there is no more QSTA to be polled.

II. RELATED WORK

Y. F. Tan et al., [6] presented a model for improving utilization in IEEE 802.11e wireless LAN via a Markov decision process (MDP) approach. A Markov chain tracking the utilized transmission window for two separate access mechanisms is devised. Subsequently, the action space and the rewards of the MDP are judiciously selected with the aim of improving overall utilization without explicit blocking. The proposed MDP model for 802.11e reveals that proportional allocation of access opportunities improve overall utilization compared to completely randomized access. Simulation results go on to show that a policy that limits HCCA access as a function of channel load improves utilization by an average 8 %. The optimization framework proposed in their work is promising as a practical decision support tool for resource planning in 802.11e. [7] **Skyrianoglou et al., 2006**presented a novel traffic scheduling algorithm for IEEE 802.11e, referred to as ARROW (Adaptive Resource Reservation over WLANs), which aims at providing improved performance for the support of multimedia traffic. The novel characteristic of this algorithm, compared to previous proposals, is that it performs channel allocations based on the actual traffic buffered in the various mobile stations, i.e., on the exact transmission requirements. This feature renders ARROW ideal for variable bit rate traffic. However, an enhancement is also presented that improves ARROW performance under constant bit rate traffic.[8]**Feiler et al. 2013** developed requirements and architecture design defects make up approximately 70% of all defects, many system level related to operational quality attributes, and 80% of these defects are discovered late in the development life cycle [Redman 2010]. Exponential growth in software size and complexity has pushed the cost for the current generation of aircraft to the limit of affordability. They present four pillars of an improvement strategy for an integrate-then-build practice that result in early defect discovery and increased confidence through incremental end-to-end system validation and verification throughout the life cycle. **Singh & Tripathi 2015**described the utilization of extended ad hoc on-demand distance vector (AODV) routing protocol for communication[9] between ad hoc network and fixed wired network. Their work uses the IEEE 802.11e medium access control (MAC) function HCF Controlled Channel Access (HCCA) to support quality of service (QoS) in hybrid network. In their work, two simulation scenarios are analysed for hybrid networks. The nodes in wireless ad hoc networks are mobile in one scenario and static in the other scenario. Both simulation scenarios are used to compare the performance of extended AODV with HCCA (IEEE 802.11e) and without HCCA (IEEE802.11) for real time voice over IP (VoIP) traffic.

III. OVERVIEW HCCA SCHEDULING ALGORITHM

The mechanism of HCCA utilizes the central control point (Hybrid Coordinator, HC) to control the access of wireless media. When joining the flow, the QSTA will send out an ADDTS request for the HC. Then the HC will be on the TSPEC field of the ADDTS request. In the IEEE 802.11e standard, the Sample Schedule will start the Controlled Access Phase (CAP) in one regular cycle by its length. The length of this cycle is called the Service Interval (SI). The procedure begins from the calculation of the SI [10].

In HCCA, QoS-capable AP (QAP) sends CF-Poll frame to QoS-capable STA (QSTA) to enquire whether there is data to send in the inquiry mechanism of HCCA. Besides, data packet queue is sorted based on the requirements of communication service stream of every station. In every polling process, TXOP is assigned to every QSTA, indicating the data packet transmission start time and the longest duration. HCCA TXOP is calculated according to traffic specification parameter of every QSTA data. Then, HCCA TXOP is transmitted along with CF-Poll frame to each QSTA [11].

HCCA mode, after QAP receiving request messages of QoS from QSTAs, the data stream, which is waiting for the transmitting in polling dispatcher of Hybrid Coordination

(HC)[12], is scheduled by the control mechanism. According to the sample scheduling algorithm in calculating TXOP, the model of TS can be described as the following equation (i).

$TSj = (Lj, \rho j, SIj)$ ………………. (i)

where Lj means mean data length of the TSj, ρj means mean data rate of the TSj and SIj means service interval of the TSj.

The calculation of SI The *SI* is the time interval for one station between two TXOPs. In HCCA, the *SI* of each QSTA is the same. Therefore, the public *SI* is not greater than the longest *SI* of each QSTA. Besides, the public *SI* is the largest factor of beacon interval.

The Frame structure of TSEPj sent by QSTAj, the assignment of TXOP for each QSTAjis calculated by HC.

As a result, TSj can be transmitted instantly in *SI*. Therefore, the number of MSDUs produced by TSj in *SI* can be calculated as:

$Nj = \frac{SI.\rho j}{Lj}$ …………….(ii)

Where *SI* is the service interval calculated by step (i),

The transmitting of one maximum MSDU at least, the duration of TXOP can be calculated as the following equation (iii).

$TDj = \max(\frac{Nj.Lj}{Rj} + O, \frac{M}{Rj} + O)$……………….(iii)

TXOP length,Rjmeans minimum physical data rate, *M* means the maximum MSDU and *O* means the time overhead.

The current TS is capable to transmit. Otherwise, the request of transmitting is denied.

$\frac{TDl+1}{SI} + \sum_{j=1}^{l} \frac{TDj}{SI} < \frac{T-Tbp}{T})$ ………………(iv)

Where l is the number of TSj that are already in OAP, T is a beacon interval and Tbp is the duration of EDCA.

IV. PROPOSED SYSTEMS

In this proposed work, we implemented as the HCCA technique used for new mechanism designed. To study the IEEE 802.11e based standard protocols and their evaluation in hard real time scenarios. To implement the HCCA flow control mechanism based scheduling in using hard real time scenario. To implement the optimize access control mechanism to achieve high throughput and low end delay and low loss rates. Compare the proposed performance approach with the base paper approach to check the robustness of the system.

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 colours in optical communications.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. So the proposed work 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.

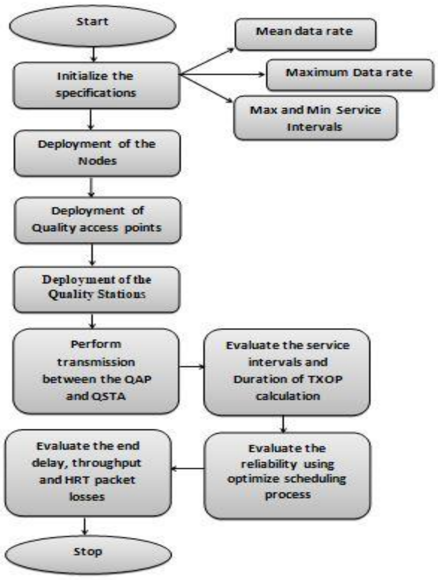

Fig 1. Proposed Model

V. SIMULATION RESULTS

In this section, we discussed with the simulation results that the deployment of the nodes. It also shows the Quality access points and Quality stations. The network area is considered 1000 meters in length and width. The nodes are deployed in a random fashion.

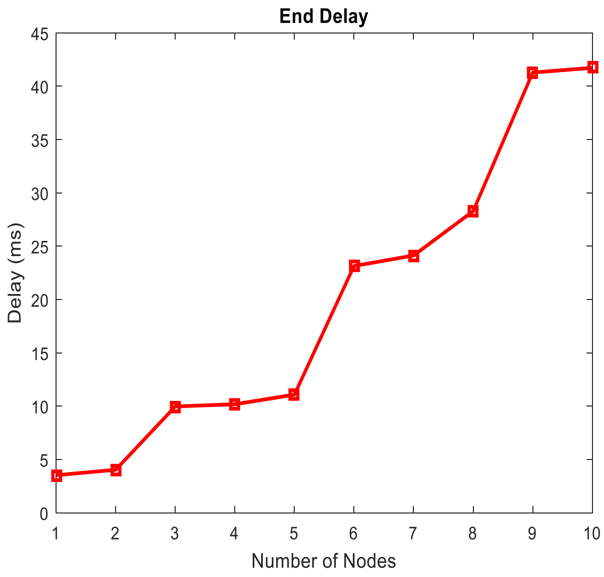

Fig 2. End Delay in HCCA

The above figure 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.

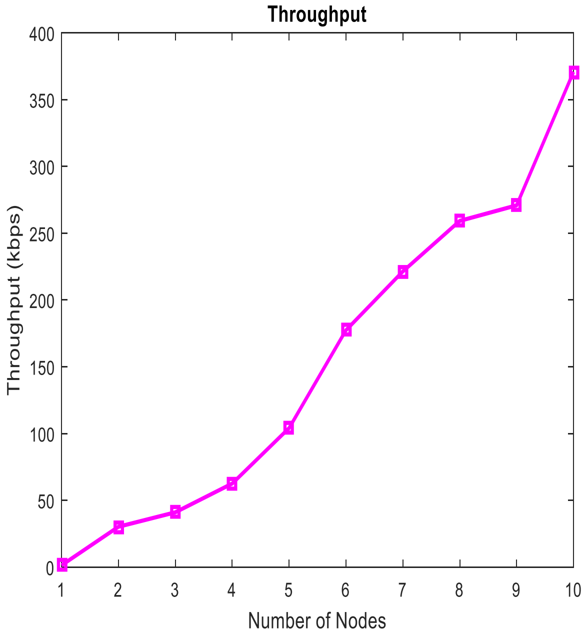

Fig 3. Throughput with HCCA

The above figure 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 efficient of the system.

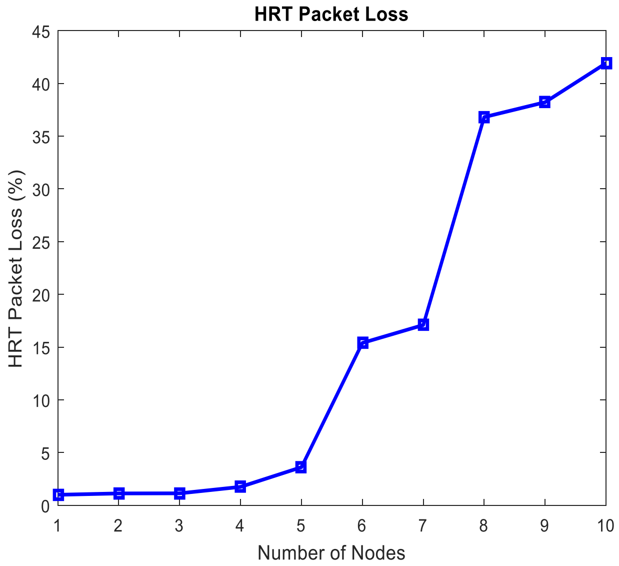

Fig 4 Hard Real Time Packet Loss in with Scheduling

The above figure 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.

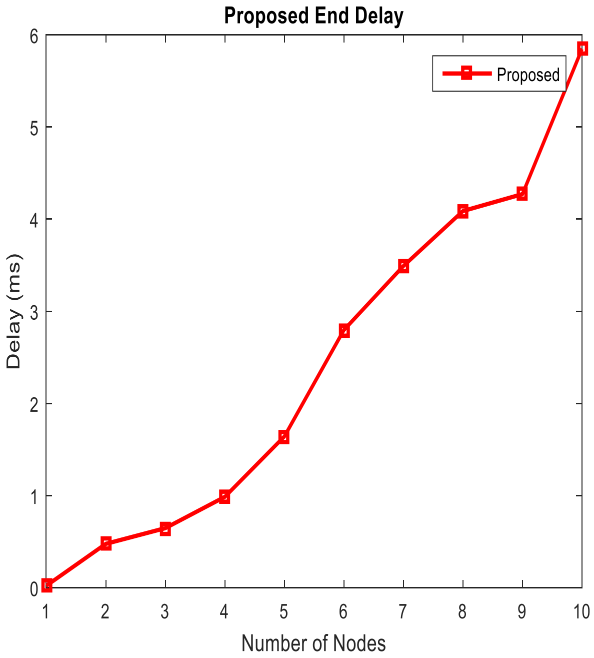

Fig 5. End Delay with Scheduling

The above figure 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. So our proposed approach is able to achieve less end delay which must be less for high efficiency

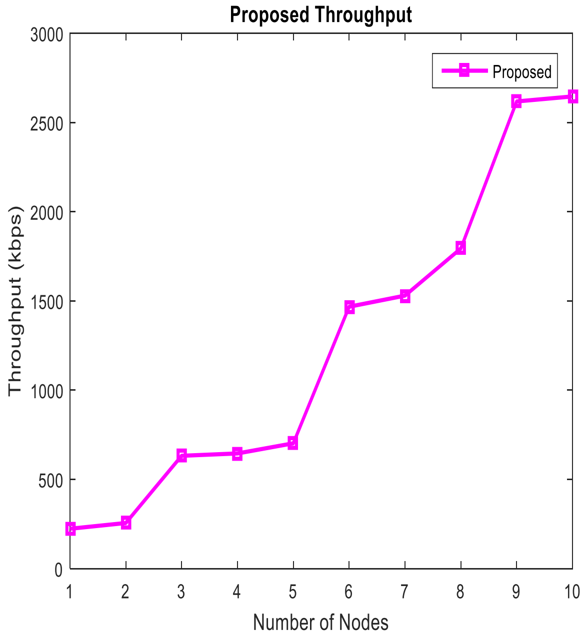

Fig 6. Throughput with hard real time scheduling

The above figure shows the proposed throughput in bits per second in hard real time scheduling process 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

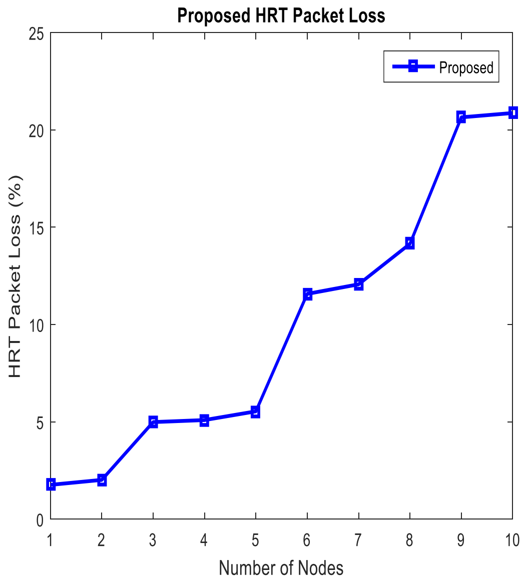

Fig 7. Proposed HRT Packet Loss

The above figure shows the proposed HRT packet losses for the low bit rates and shows that our proposed approach is able to achieve less packet losses than the base approach which must be low for the less bit error rates.

Table 1. Comparison table in Proposed and Existing Work

Parameters	Base	Proposed
End Delay	27 ms	6 ms
HRT packet loss	43%	22 %
Throughput	425 Kbps	2700 kbps

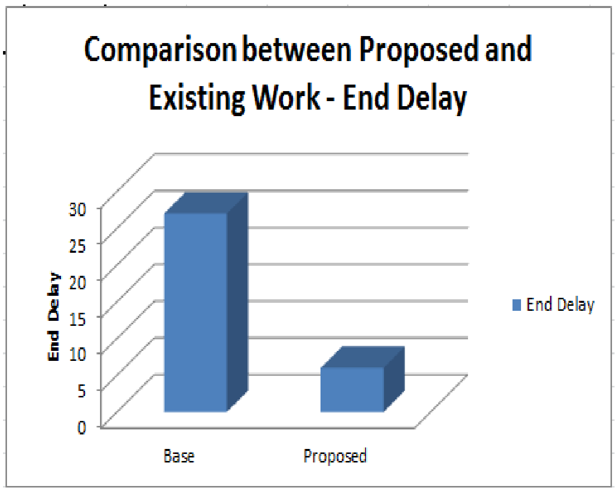

Fig 8. Comparison between Proposed and Existing work – End Delay

The above figure 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

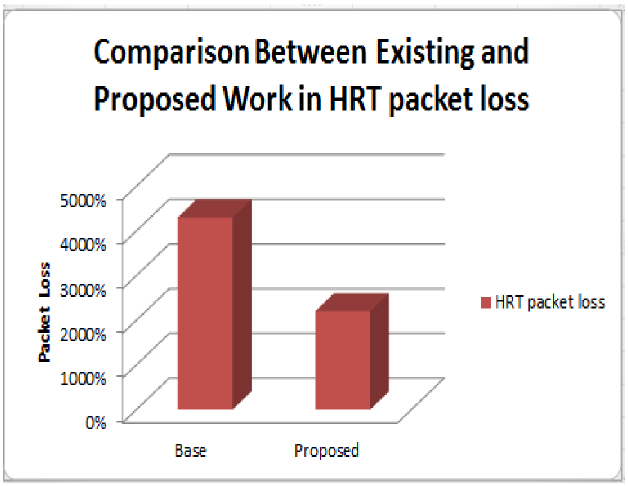

Fig 9. Comparison between Proposed and Existing work - Packet Loss

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.

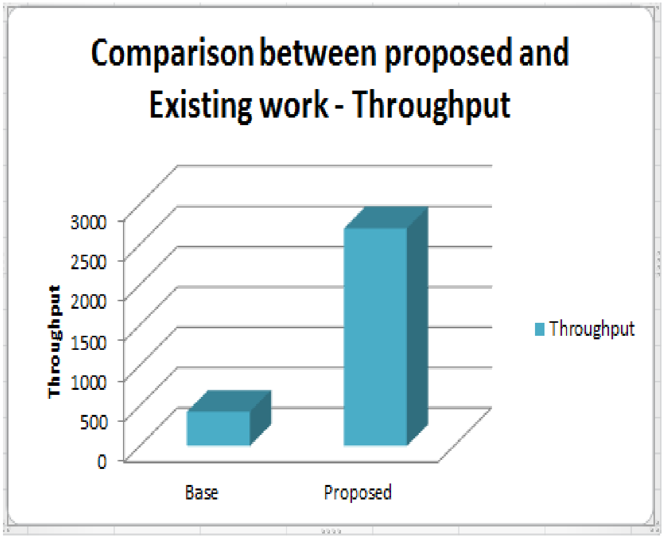

Fig 10. Comparison between Proposed and Existing work - Throughput

The above figure shows the throughput comparison between the base approach and proposed approach and shows that the proposed system is having high throughputs than the base approach.

VI. CONCLUSION AND FUTURE SCOPE

In this conclusion, we implement the HCCA algorithm and Reliability Factor used with the scheduling process. The algorithm sets priorities of TS according to the HRT attribute of TS and calculates TXOP for HRT TS by using the max transmission speed instead. Besides, the algorithm adjusts the TXOP queue dynamically as well. Finally, by using the simulative method, it turns out that the read-time packet loss rate can be effectively reduced and the 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 proposed work 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.

The Future plans include the development of a complementary admission control algorithm to avoid fast deterioration of ARROW when input load exceeds the maximum affordable capacity, as indicated by simulations.

VII. REFERENCES

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