TRANSMISSION QUALITY AWARE OPTIMUM CHANNEL SCHEDULING (QAOCS) FOR 802.11A WLAN

MACHA SARADA[1]DR. AVULA DAMODARAM[2]
[1]Asst., professor, MIST for Women, Khammam,JNTUH, Telangana State, India
Email: sarada.macha@gmail.com
[2]Vice chancellor, SV university, Tirupathi, Andhra Pradesh, India

ABSTRACT:

WLAN networks have emerged as the most deployed last stage component of internet connectivity to mobile users. Growing subscribers of WLANs for Wi-Fi accessing devices is driving the traffic in WLANs. Accordingly, WLAN services are prone to severe declines in performance amid channel interference and contention. To address rising traffic issues and performance degradation, a novel channel scheduling strategy is proposed. Unlike the most of the contemporary models, the proposed model schedules the channels based on multi-objective QoS factors, moreover it balances the load by transmitting buffered data packets as transmission-window. The contention state of channel availability also addressed in this proposal. The research work depicts that the recommended algorithm signifies the improved throughput, defused drop ratio, and also distributes the user traffic based on optimizing channel scheduling.

Keywords: WLAN, 802.11a, 802.11ac, Channel scheduling, Access point, OCA-ITU.

1 INTRODUCTION

The usage of Wi-Fi accessible devices among WLAN clients is growing at a rapid pace. To handle such huge subscriber base, WLANs are being heavily deployed to cater high-speed internet access to its mobile clients. For instance, according to the estimations of wigle.net, over 33 Million clients are subscribed Wi-Fi networks. A Wireless LAN services provider- Sky-Hook, stated that it has approximately "tens of millions" of APs globally in its database. Driven by such massive adoption of Wi-Fi infrastructures and significant developments of 802.11 families, WLANs continue to play a significant role in providing data services for mobile clients. With increased utilization rates of Wi-Fi enabled devices such as a Smartphone, laptop and iPad data traffic across WLANs will be visualized. These are often overloaded at locations where special events will conduct, for instance, office conference halls and sports stadiums. In such case scenarios, the subscribers of WLANs will come across a declined performance of the network as a result of channel interference and contention.

1.1 Problem Formulation and Objectives

The most of the research related to quality transmission in WLAN concentrating on enhancing the performance measures of overloaded WLANs. Predominantly, the contemporary contributions have focused on scheduling packets in the downlink traffic (AP to clients), as the link transmits the majority of data. In a general scheduling method, FIFO (First-In-First-Out) conceptual model will implement at APs. According to this scheduling concept, the packet which is arrived first will be the first one to execute through the wireless channel. This process operates efficiently under light loads, where each downlink packet will be transmitted to respective clients with reduced latency time at the nodes. However, this could not happen with heavy loads. With increased traffic flow, the execution and packet transmission time in the downlink will be increased. Thus, APs cannot be able to process the immediate request from the internet. Instead, the incoming data packets maintain a queue method at each AP to buffer. Every data packet has its characteristics regarding size and rate of transmission to the client, which differs from the other in the Queue. However, this

FIFO scheduling process functions by ignoring all such distinct features of the packets to optimize the performance levels. When nodes send data packets with low transmission rates, an increase in the response time of packets already in the queue can be observed.

To overcome such deficits, this manuscript focused on implementing a new algorithm for channel scheduling against the buffered data packets as transmission-window under multi-objective transmission quality factors. Also, the proposal was also addressing the issue of contention, which is based on the reformation of multiple transmission-windows from busted transmission-window that causes contention.

2 RELATED WORK

Efficiency and fairness are considered as core and traditional parameters for packet scheduling across the networks. These metrics have been studied deeply in WLANs also. In particular, performance measures involve Transmission-Control-Protocol (TCP) flows [1], [2], [3], [4], [5]. Handling overload and stiff competition between data packets of TCP and TCP acknowledgments (TCP ACKs) are becoming a major issue, predominantly when taking into account of channel errors.

This research work primarily focuses on the Medium Access Control (MAC) layer scheduling process. By combining TCP flows with contemporary solutions, this process allows structure scheduling across layers. The afore-mentioned TCP flows are also used to enhance throughput and fairness values by controlling entire WLANs. This is made feasible by strategically connecting clients with access points [6], [7], [8], [9], [10] and [11] and allocating channels to APs [12], [13] and [14] or by any other hybrid approaches [15]. In general, the default link will form an association for the client with the nearest AP (with best signal strengths). However, this policy is unable to meet the optimal level of networking, as a Wi-Fi network comprises a diversified set of APs. Accordingly, the default frequency channel choice of each access point is arbitrary and does not consider interventions with closest APs. Majority of earlier research works has prior requirements for central control and synchronization among APs.

As this research proposes scheduling process at packet level for a single node, earlier works act as complementary to the research in this paper. In addition, existing literature also studied on multiple AP scheduling processes to reduce power consumption [16], [17], [18], [19] and [20]. The primary goal of approaches is to adjust the AP scheduling so that the users who are in connection with the closest AP can remain in the mode of power saving as far as possible. This study primarily focuses on conducting scheduling process on overloaded AP in a fully packed Wi-Fi network, where the method for power saving is disabled.

Further, by upgrading 802.11 guidelines, few models [21], [22] are proposed. These are aimed at accomplishing fairness among the clients based on time in WLANs. They rely on the significance of rate adjustment algorithms and specific upgrades to 802.11 standards. This paper majorly opts for MAC layer scheduling, attempts throughput fairness. Packet scheduling mechanism in wireless networks is often considered to provide QoS metrics characterized by the IEEE 802.11e standard [23]. In this standard, traffic with the highest priority gains greater opportunities for transmission as compared to the traffic with low priority. This is could be feasible by giving shorter delay based parameters like Contention Window (CW) and Arbitration Inter-Frame Space (AIFS).

The access-point projected in this paper is also supportive to QoS distribution scheme. While 802.11e is engaged in recognizing traffic with different priorities, this distribution scheme has enough capacity to schedule distinct traffics with the same priority. Multiple researchers identified that the utilization of POCs is not destructive at all time. In fact, proper usage of POCs in combination with NOCs will lead to significant enhancements in utilization rates of the spectrum and also improves the performance of the application.

By deploying the afore-mentioned concepts, numerous schemes for assigning channels have been implemented, which makes the use of both NOCs and POCs to optimize the throughput [24], [25], [26], [27] and [28]. Further, a distributed algorithm for channel assignment is proposed to cater real-time scheduling solutions in [29]. This approach formulated the channel allocation task as a throughput optimization task.

In addition to vast research made on the scheduling task, several studies are in progress focusing on scheduling algorithms to improve the throughput levels achieve high-performance measures. In [30], an approximate algorithm is proposed to maximize the throughput while simultaneously reducing the interference. In addition, a resourceful mechanism called User-AP Association Control is proposed in [31], for obtaining Max-Min fair bandwidth assignments.

Multiple authors identified channel assignment together with traffic routing as key parameters for maximizing throughput across wireless mesh network [25], [32]. According to these studies, a mesh network and the neighbouring traffic outline will be established. They tried to address both channel allocation and routing for every flow such that specified demand for traffic through the traffic outline will be fulfilled. The achieved throughput varies based on scheduling of user traffic. In case of using several links utilizing POCs and NOCs to improve the throughput, some clients may face performance declines due to their unfavourable positions.

Though the models depicted contemporary literature are endeared to achieve optimality in transmission through efficient channel scheduling, they limited to near optimality, which often tends to expires the packets due to delay in channel allocation, or the selected channel may not be optimal.

The proposal of this manuscript is an optimal channel scheduling algorithm for wireless Lan, which frames the data to transmit that buffered at access point as a transmission-window, and schedules it an optimal channel that selected through the assessment of multi-objective transmission quality factors. The proposal was also addressing the issue of contention raised due to the busted transmission-window. In order to handle the contention, the proposed model is segmenting the busted transmission-window as multiple transmission-windows and performing the optimal channel selection to schedule the resultant transmission-windows.

3 TRANSMISSION QUALITY AWARE OPTIMUM CHANNEL SCHEDULING (QAOCS)

The proposed model called Transmission Quality Aware Optimum Channel Scheduling (QAOCS), which is a model devised as an extension version of our previous work called Optimal Channel Allocation and Idle Time Usage (OCA-ITU) [33]. The OCA-ITU is an adaptive channel scheduling to data frames (pool of packets) in wireless LAN, in particular at access points that critically utilizes the idle time between two consecutive schedules of the channel. This scheduling strategy OCA-ITU schedules data frames to respective channels regarding available channel bandwidth and the possibility of idle time usage. However, the other QoS factors are not considering regarding channel scheduling. Hence, it often evinces the lower side of the transmission performance against crowded transmission requests at public access points. Unlike the OCA-ITU, the proposed QAOCS is assessing the impact of multiple objectives of the transmission quality of channels, such as deferment rate, occupancy intercession rate, channel desertion rate, transmission realization rate, bandwidth against the load, and Schedule Interval. In regard to this here we proposed a new scale called Channel Optimality Ratio (cor) that explores the scope of respective channel quality metrics. The higher values of the Channel Optimality Ratio (cor) indicates the significance of that channel. The process of QAOCS strategy follows:

The controller of the respective access points buffers the packets to balance their transmission latency. Further reframes the set of packets as transmission-window, and shares the information to access-point regarding transmission-window that includes arrival time, transmission session timeout, window size, and required bandwidth. This information sharing can figure out through a control packet in respective to transmission frame transmission The arrival time is the sum of the time is necessary for a transmission-window to reach access point, and the time is taken to share the information related respective transmission frame that commonly referred as offset -time.

Let $p(cf_i)$ be the time taken to process control frame cf_i, $\tau(cf_i)$ be the time taken by the cf_i toreach the access-point from the assembler and $\tau(b_i)$ be the assessed time to transmit transmission-window b_i from assembler to access-point. Then total expected transmission time $ett(b_i)$ will be measured as explored in (Eq1).

$$ett(b_i) = p(cf_i) + \tau(cf_i) + \tau(b_i) \; ..... \; (1)$$

Here in the eq1, $ett(b_i)$ is the total time expected to be taken by transmission-window b_i to reach the access point.

3.1 QAOCS Scheduling Strategy

Once the control frame arrives, the access-point initiates the process of scheduling. Regarding this, the access-point explores the desired transmission properties called bandwidth in demand, required time slot of the channel. Further channel allocation process under QAOCS that explored following.

Initially, the said model is assessing the values of the projected channel's transmission quality metrics of all available channels and orders these channels according to one of the projected quality metric that considered as a primary requirement of the transmission quality.The strategic approach to assess the scope of each transmission quality metric that projected regarding the available channels is explored in the following section.

The transmission controller of an access-point receives data packets from multiple users and buffers according to their latency in arrival time, and further, frames transmission-windows that is a pool of buffered data packets. Further, access point schedules these transmission-windows to optimal channels that transmit data to the destination. The objective of this manuscript is an optimum channel scheduling regarding achieving maximal transmission quality.

The set of channels controlled and scheduled by an access-point s_i are $cs_i = \{c_1, c_2, c_3, ...c_x\}$. Henceforth the channel allocation under the access-point s_i is from set of x channels available.

The scheduling of a channel to a transmission-window is needed to be transmission quality specific. The channel selection by Channel Optimality Ratio that scheduled to corresponding transmission-window is proposed in this manuscript. The factors of transmission quality projected in this regard are described as follows:

- A channel can be rated best under a specific QoS factor but might fail to deliver the same performance under the consideration of multiple QoS factors.
- A channel can be rated divergently concerning its various QoS factors. As an example, a channel S can be best with respect to bandwidth availability, but the same channel might be moderate regarding desertion rate, worst in the context of Occupancy intercession rate.
- The importance of the QoS factors might vary from one scheduling context to other.

According to the impact of QoS factors of the channels described, it is evident that the best-ranked channel under single QoS factor is not always optimal to select a channel. The channel that performed well under some prioritized QoS factors are always need not be the best fit under other prioritized QoS factors. In regard to this, the devised scale Channel Optimality Ratio finds the optimum channel. The channels are ranked according to their Channel Optimality Ratio and will use in the same order to finalize a channel towards selection and scheduling.

The QoS metrics of each channel considered to assess the optimum channel for selection and scheduling are described below. The metrics are the mix of desired value high and low.

- Deferment rate: This metric depicts that how frequently the rescheduling of the transmission-windows that scheduled to the corresponding channel is observed. This metric is said to be optimal with lower values. This can measure as follows in(Eq2).

$$dr(c_i) = \frac{\sum_{j=1}^{sc_i} \{1 \exists if\, (differement\, of\ channel\ c_i\ is\ positive)\}}{sc_i} \quad \ldots\ldots(2)$$

    - Here in the above equation $dr(c_i)$ indicates the deferment rate of the channel c_i, which is the ratio of the count of deferment observed against the number of times channel c_i scheduled sc_i is indicating the number of times rescheduled earlier, and $csc(c_i)$ is showing the actual number of times the channel c_i scheduled.
- Occupancy intercession rate (-): This metric indicates the ratio of elapsed schedules of the channel against the number of times that channel scheduled. This metric can be measured as follows in (Eq3):

$$oir(c_i) = \frac{\sum_{j=1}^{sc_i} \{1 \exists if\, (elapsed\ transmission\ time\ of\ channel\ c_i\ is\, observed)\}}{sc_i} \quad \ldots.(3)$$

    - Here in the above equation $oir(c_i)$ is indicating the Occupancy Intercession Rate.
- Desertion rate: Is also another negative metric, which indicates the possibility of channel desertion during channel utilization. This metric can be measured as follows in(Eq4):

$$der(c_i) = \frac{\sum_{j=1}^{sc_i} \{1 \exists if\, (desertion\, of\ scheduled\ channel\ c_i\ is\, observed)\}}{sc_i}$$

…(4)

    - Here in the above equation $der(c_i)$ indicates the ratio of desertion against the number of scheduled times of respective channel c_i.
- Transmission realization rate: This metric is the ratio of transmission realizations against the number of times that channel was scheduled, which can be measured as follows in(Eq5).

$$trr(c_i) = \frac{\sum_{j=1}^{sc_i} \{1 \exists if\, (transmission\, realization\, of\ channel\ c_i\ is\, observed)\}}{sc_i} \quad \ldots(5)$$

    - Here in the above equation $trr(c_i)$ is indicating the transmission realization rate of the channel c_i.
- Bandwidth against load: This factor is principle QoS factor since the sufficient bandwidth is essential to perform transmission with the minimum guarantee. The bandwidth available at a channel must be greater than the required bandwidth of the current transmission-window to be scheduled and must not exceed the sum of bandwidth required for current transmission-window and reserve bandwidth threshold given. If the channel bandwidth is less than the required bandwidth or greater than the sum of required bandwidth and reserve bandwidth threshold then it represents the in optimality is the negative factor and if it is in between required bandwidth and sum of required bandwidth and reserve bandwidth threshold then positive factor. The measuring of bandwidth compatibility is as follows in(Eq6).

$$bc(c_i) = ba(c_i) - br(c_i) \quad \ldots\ldots (6)$$

    - Here in the above equation $bc(c_i)$ is indicating the bandwidth capacity of the channel c_i, $ba(c_i)$ is indicating the bandwidth available at the channel c_i and the '$br(c_i)$' is the bandwidth required at c_i for current transmission-window scheduling.
    - This $bc(c_i)$ must be less than the given reserved bandwidth threshold rbt since $bc(c_i) > rbt$ indicates that channel c_i is oversized for current scheduling bandwidth requirement, which can reserve for future scheduling with high bandwidth requirement.
- Schedule Interval State (sis): The Schedule Interval of the channel must be greater than the total transmission time required for current transmission-window to be scheduled, if not that channel not eligible for scheduling, hence this factor is also principle QoS factor. Since the Schedule Interval must be higher than the required transmission time, and must not be greater than the sum of necessary transmission time and reserved transmission time threshold rit. If it is higher than the required and less than the rit then it is optimal, if it is greater than the $rsit$ then it is infeasible to schedule. This can be measured as follows in(Eq 7).

  $$sis(c_i) = asi(c_i) - rsi(c_i) \qquad \ldots\ldots (7)$$

    - Here in the above equation $sis(c_i)$ indicates the schedule interval state of the channel c_i, the notation $asi(c_i)$ indicates the available schedule interval of the channel c_i, and the notation $rsi(c_i)$ indicates the required schedule interval of the channel c_i to transmit the target transmission-window.
    - If $0 < sis(c_i) \le rit$ then the channel c_i is optimal if not infeasible to schedule.

3.2 Evaluation strategy of Optimality Ratio of Channels

Let deferment rate (dr), occupancy intercession rate (oir), desertion rate (der), transmission realization rate (trr), bandwidth against the load (bc), and Schedule Interval State (sis) as a set of QoS metrics $M = \{[dr(c_i), oir(c_i), der(c_i), trr(c_i), bc(c_i), sis(c_i)] \forall i = 1 \ldots x\}$ of available channels $C = \{c_1, c_2, \ldots\ldots c_x\}$ under access-point s_j.

The QoS factors $bc(c_i), sis(c_i)$ are principle metrics, which are using to find the compatibility scope of each channel. This principle score is used to order the channels, which assessed as follows

Then find the principle score as follows:

Initial process normalizes the bandwidth compatibility and schedule interval as follows:

```
step 1. $\overset{x}{\underset{i=1}{\forall}} \{c_i \exists c_i \in C\}$ Begin
step 2. $diff \leftarrow rbt - bc(c_i)$ // the set $diff$ contains
        the difference between the excess bandwidth $bc(c_i)$ of each channel $c_i$
        against reserved bandwidth threshold $rbt$
step 3. $diff_{abs} \leftarrow abs(diff\{c_i\})$ //The set $diff_{abs}$
        contains the absolute values of the entries in $diff$
step 4. End
step 5. $\overset{x}{\underset{i=1}{\forall}} \{c_i \exists c_i \in C\}$ Begin
step 6. $bc(c_i) = 1 - \frac{1}{(diff\{c_i\} + \max(diff_{abs}) + 1)}$ //
        normalizing the bandwidth compatibility such that the channel with most optimal
        compatibility related to bandwidth will have higher value, which is between 0 and 1.
step 7. End
step 8. $\overset{x}{\underset{i=1}{\forall}} \{c_i \exists c_i \in C\}$ Begin
step 9. $diff \leftarrow rit - sis(c_i)$ // the set $diff$ contains
        the difference between the excess schedule interval $sis(c_i)$ of each channel $c_i$
        against reserved interval threshold $rit$
```

```
step 10. $diff_{abs} \leftarrow abs(diff\{c_i\})$ //The set $diff_{abs}$ contains the absolute values of the entries in $diff$
step 11. End
step 12. $\overset{x}{\underset{i=1}{\forall}}\{c_i \exists c_i \in C\}$ Begin
    step 13. $sis(c_i) = 1 - \frac{1}{\left(diff\{c_i\} + \max(diff_{abs}) + 1\right)}$ // normalizing the schedule interval state such that the channel with most optimal schedule interval state will have higher value, which is between 0 and 1.
step 14. End
step 15. $\overset{x}{\underset{i=1}{\forall}}\{c_i \exists c_i \in C\}$ Begin
    step 16. $ps(c_i) = 1 - (bc(c_i) \times sis(c_i))$ //The product of two decimal fractions result from the lesser decimal fraction. Hence, the product of depicted bandwidth compatibility $bc(c_i)$ and session interval state $sis(c_i)$ is subtracted from 1, which is to obtain the higher value of the product.
step 17. End
```

Then the available channels are ranked in ascending order of their principle score, such that the channel with lowest principal score will rank as 1, and channel with highest principal score will rank as x (channel count). Similarly, the channels are ranked for each of the other QoS metric, such that channel ranked as 1, which is having less optimal value for the corresponding QoS metric, and the channel having highest optimal value retains the highest rank x. This means that the ranks will be assign in ascending order of the values, if the higher values are optimal, else the ranks will be assigned in descending order of the values, if lower values are optimal. The outcome of this process is that each channel entitled with multiple ranks for multiple transmission quality factors. Further, these ranks will be used as input to measure the Channel Optimality Ratio cor.

Let the rank set of a channel $[c_i \exists c_i \in C]$ is $R(c_i) = [r_{ps}, r_{dr}, r_{oir}, r_{der}, r_{trr}]$, then Channel Optimality Ratio (qdi) of each channel can be measured as follows.

$\overset{x}{\underset{i=1}{\forall}}\{c_i \exists c_i \in C\}$ Begin

$$R_\mu(c_i) = \frac{\left\{\begin{array}{l}\left(r_{ps} + r_{dr} + r_{oir} + r_{der} + r_{trr}\right)\exists \\ \left(r_{ps}, r_{dr}, r_{oir}, r_{der}, r_{trr}\right) \in R(c_i)\end{array}\right\}}{|R(c_i)|}$$

// the above equation represents the average of the ranks obtained for different metrics of channel c_i.

$$d(c_i) = \frac{\left\{\begin{array}{l}\sqrt{\left(R_\mu(c_i) - r_{dr}\right)^2} + \sqrt{\left(R_\mu(c_i) - r_{oir}\right)^2} + \\ \sqrt{\left(R_\mu(c_i) - r_{der}\right)^2} + \sqrt{\left(R_\mu(c_i) - r_{trr}\right)^2} + \\ \sqrt{\left(R_\mu(c_i) - r_{ps}\right)^2}\end{array}\right\}}{|R(c_i)|}$$

$$ocr(c_i) = \frac{1}{d(c_i)}$$

The above equation is derived from the process of calculating the root mean square distance of the ranks allocated to the corresponding channel for different QoS metrics. Here in above equation, $R_\mu(c_i)$ represents the mean of all ranks of different QoS metrics of the channel c_i.

Then the channels will be arranged in descending order of the rank regarding principle score.

Further, select the set of channels having rank related to principle score that more significant than the given principle score rank threshold.

Further arrange the channels selected based on principle score rank in descending order of their channel optimization ratio cor, which helps to project the best channel in first place of the ordered list. The same order is the preferred order to choose channels in regard to schedule the transmission-window.

The negative factors such as (i) no channel available with desired values of principle QoS metrics or (ii) transmission-window arrival time threshold lapses will be handled under QAOCS as follows:

If the compatible channel is not found (no channel available with desired principle QoS metrics), if transmission-window arrival time threshold intervals that leads to slide of framed time threshold of the allotted channel, or if more than one transmission-window found with comparable channel requirements and required proper channels are fewer than the demand. Then the transmission-window reformation as small segments will be done, and the QAOCS scheduling will be done recursively till the scheduling process succeed.

If transmission-window reformation failed to proportionate the number of new transmission-windows and number of channels with idle time available, then drops excess new segments and acknowledges the same to transmission controller, henceforth the transmission-window assembler includes the packets of the dropped segments into next transmission-window assembly.

Here in the process of QAOCS, it initially attempts to trace the optimum channel under the impact of different QoS metrics, if optimal channel is not found, then attempts to segment the transmission-window into multiple and schedules, which is recursive till it succeeds in scheduling. Here the segmentation is on demand, since the process finds available optimum channel and then segments available transmission-window into two segments such that one of that segments is optimal suits the selected optimum channel, then repeats the same for the leftover segment.

4 EXPERIMENTAL STUDY

4.1 Experimental Setup

Simulation studies for evaluating the efficiency of the proposed methods termed as QAOCS is executed based on the standards of 802.11A, 5GHZ processor. A total of 150 channels are included in the evaluation process [34]. The experimental model is built based on [35] NSF topology, which is tested through NS2 and WLAN technique. Node count included in the testing phase varied from 55 to 100. Mean of transfer-windows delivered was around 1000 pps to 6000 pps. For other specifications including window volume, accessibility of bandwidth and unutilized duration were left to vary dynamically. The key strategy adapted for the execution was location division strategy, which divides the data on a random basis. A time period for the execution phase was between 11 minutes to 38 minutes.

4.2 Performance Analysis

The suggested QAOCS model is assessed through a comparison with the previous approach termed OCA-ITU referred in [33]. Further, different methods including POCS [28], PCS [36] are also compared with the proposed model. Comparison parameters for evaluating the efficiency of these models include drop ratio, throughput, segmentation efficiency, costs involved, comparison to an oversized- window transfer.

Simulation results depict that the procedure complicatedness of QAOCS is smaller and is in comparable levels to that of OCA-ITU [33]. This is because of similarity in segmentation and re-scheduling sequences involved in QAOCS and OCA-ITU. Both the approaches are observed to have low complicatedness unlike POCS and PCS driven by efficient rescheduling in cases of absence of the desired channel in the window scheduling phase.

Contrary to the other two approaches, OCA-ITU model re-segments the window on the basis of accessible desired channels. The segmentation is implemented only one time as the assembler is updated with existing channel condition. In case re-segmentation is executed within the considered duration, then reselection of channel need not be performed and on the other hand, if it exceeds this duration, only then the channel condition should be revaluated, and rescheduling begins. The complexity in QAOCS is small because of the adapted re-segmentation strategy on similar lines of OCA-ITU.

As the QAOCS is developed on the principles of OCA-ITU, this model also posed similar efficiency regarding complexity involved in the process. The window drop rate in the proposed model is observed to be steady and at comparable levels to other methods.

In terms of optimality of the channel, the proposed model has better performance as compared to OCA-ITU. The low loss ratio of windows is found in QAOCS, resulting in highest throughput. Similar to window loss rates, throughput is steady and most elevated in the proposed model.

Despite time required for choosing the optimal channel in the proposed model is higher than OCA-ITU, efficiency regarding parameters including throughput and low drop rates result in the overall decline in complexity.

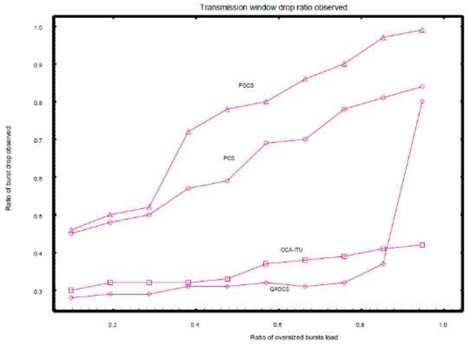

Figure 1: Transmission-window drop ratio observed under divergent oversized transmission-windows load

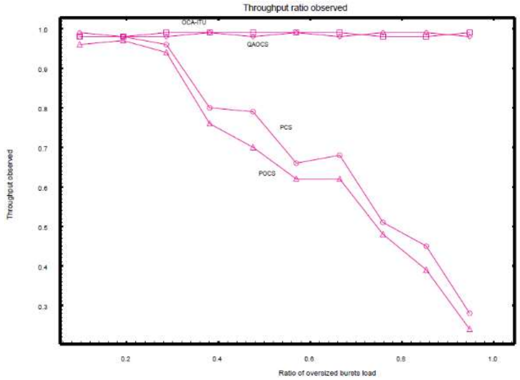

Figure 2: Throughput observed against divergent oversized transmission-windows load

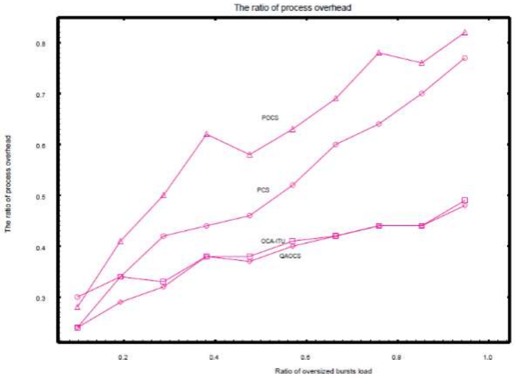

Figure 3: Process overhead versus Transmission-window load.

Figure 1 depicts window drop rate compared with the different oversized transmission-windows load. The analyzed window drop is compared with an oversized load, which is divided through location allocation approach. It can observe from the figure that both QAOCS and OCA-ITU approaches far exceed other models in this parameter.

Figure 2 compares the model throughput of different models. It can observe that OCA-ITU and QAOCS models are much superior in performance compared to other models.

As the drop rate decreases with increase in throughput and vice-versa being true, the transmission model suggested in this manuscript has higher efficiency regarding drop rates as can be observed in Figure 1. This is resulting in the strong boost in the throughput value of the model. Further, driven by advanced re-segmenting techniques implemented in this model, complicatedness in scheduling is quite low, even though a load of control frames is more significant.This can regard as a key advancement over the existing approach.

5 CONCLUSION

This paper devised a Channel Optimality Ratio Aware transmission-window scheduling strategy for WLANs that referred as QoS Discrepancy Aware Optimum channel scheduling with Void Filling (QAOCS) Strategy. The model devised here is an extended version of our earlier model called OCA-ITU [33], and that aimed to improvise the channel selection strategy and minimize the scheduling process overhead. In regard to this, the proposed model is assessing the Channel Optimality Ratio towards optimum channel selection and also introduced a novel channel state aware transmission-window regimenting strategy. The Channel Optimality Ratio score helps to find an optimum channel under consideration of majority QoS metrics called deferment rate, occupancy intercession rate, desertion rate, transmission realization rate, bandwidth availability against the load, and Schedule Interval State. To the best of our knowledge, this is the first attempt to optimum channel selection under these number of QoS metrics is the first model in channel scheduling for overloaded data transmissions in WLAN. The channel state aware transmission-window re-segmenting allows minimizing the recursive segmenting and scheduling overhead, hence processing overhead will be downgraded to linear. Further, this work can extended, which enables the composition of multiple channels to allow the quality transmission between source and destination, which linked through numerous access points.

REFERENCES

[1] Pilosof, Saar, et al. "Understanding TCP fairness over wireless LAN." INFOCOM 2003. Twenty-Second Annual Joint Conference of the IEEE Computer and Communications. IEEE Societies. Vol. 2. IEEE, 2003.

[2] Bottigleliengo, M., et al. "Short-term Fairness for TCP Flows in 802.11 b WLANs." INFOCOM 2004. Twenty-third Annual Joint Conference of the IEEE Computer and Communications Societies. Vol. 2. IEEE, 2004.

[3] Urvoy-Keller, Guillaume, and André-Luc Beylot. "Improving flow level fairness and interactivity in WLANs using size-based scheduling policies." Proceedings of the 11th international symposium on Modeling, analysis and simulation of wireless and mobile systems. ACM, 2008.

[4] Bhagwat, Pravin, et al. "Enhancing throughput over wireless LANs using channel state dependent packet scheduling." INFOCOM'96. Fifteenth Annual Joint Conference of the IEEE Computer Societies. Networking the Next Generation. Proceedings IEEE. Vol. 3. IEEE, 1996.

[5] Bhagwat, Pravin, et al. "Using channel state dependent packet scheduling to improve TCP throughput over wireless LANs." Wireless Networks 3.1 (1997): 91-102.

[6] Balachandran, Anand, ParamvirBahl, and Geoffrey M. Voelker. "Hot-spot congestion relief in public-area wireless networks." Mobile Computing Systems and Applications, 2002. Proceedings Fourth IEEE Workshop on. IEEE, 2002.

[7] Bejerano, Yigal, Seung-Jae Han, and Li Erran Li. "Fairness and load balancing in wireless LANs using association control." Proceedings of the 10th annual international conference on Mobile computing and networking. ACM, 2004.

[8] Ahmed, Nabeel, and Srinivasan Keshav. "SMARTA: a self-managing architecture for thin access points." Proceedings of the 2006 ACM CoNEXT conference. ACM, 2006.

[9] Jardosh, Amit P., et al. "IQU: practical queue-based user association management for WLANs." Proceedings of the 12th annual international conference on Mobile computing and networking. ACM, 2006.

[10] Lee, Heeyoung, et al. "Available bandwidth-based association in IEEE 802.11 wireless LANs." Proceedings of the 11th international symposium on Modeling, analysis and simulation of wireless and mobile systems. ACM, 2008.

[11] Vasudevan, Sudarshan, et al. "Facilitating access point selection in IEEE 802.11

wireless networks." Proceedings of the 5th ACM SIGCOMM conference on Internet Measurement. Usenix Association, 2005.

[12] Manitpornsut, Suparerk, BjörnLandfeldt, and AzzedineBoukerche. "Efficient channel assignment algorithms for infrastructure WLANs under dense deployment." Proceedings of the 12th ACM international conference on Modeling, analysis and simulation of wireless and mobile systems. ACM, 2009.

[13] Mishra, Arunesh, et al. "Distributed channel management in uncoordinated wireless environments." Proceedings of the 12th annual international conference on Mobile computing and networking. ACM, 2006.

[14] Wong, Gary KW, and XiaohuaJia. "An efficient scheduling scheme for hybrid TDMA and SDMA systems with smart antennas in WLANs." Wireless networks 19.2 (2013): 259-271.

[15] Tewari, Babul P., and Sasthi C. Ghosh. "A combined frequency assignment and AP scheduling for throughput maximization in IEEE 802.11 WLAN." Proceedings of International Conference on Advances in Mobile Computing & Multimedia. ACM, 2013.

[16] Enayet, Asma, et al. "A power-aware distributed Wi-Fi access point scheduling algorithm." Proceedings of the 7th International Conference on Ubiquitous Information Management and Communication. ACM, 2013.

[17] Anand, Manish, Edmund B. Nightingale, and Jason Flinn. "Self-tuning wireless network power management." Wireless Networks 11.4 (2005): 451-469.

[18] Rozner, Eric, et al. "NAPman: network-assisted power management for wifi devices." Proceedings of the 8th international conference on Mobile systems, applications, and services. ACM, 2010.

[19] Dogar, Fahad R., Peter Steenkiste, and Konstantina Papagiannaki. "Catnap: exploiting high bandwidth wireless interfaces to save energy for mobile devices." Proceedings of the 8th international conference on Mobile systems, applications, and services. ACM, 2010.

[20] Manweiler, Justin, and Romit Roy Choudhury. "Avoiding the rush hours: WiFi energy management via traffic isolation." Proceedings of the 9th international conference on Mobile systems, applications, and services. ACM, 2011.

[21] Sadeghi, Bahareh, et al. "Opportunistic media access for multirate ad hoc networks." Proceedings of the 8th annual international conference on Mobile computing and networking. ACM, 2002.

[22] Tan, Godfrey, and John V. Guttag. "Time-based Fairness Improves Performance in Multi-Rate WLANs." USENIX annual technical conference, general track. 2004.

[23] 802.11eamendment,[Online].Available:http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=1541572.

[24] Ding, Yong, et al. "Using partially overlapping channels to improve throughput in wireless mesh networks." IEEE Transactions on Mobile Computing 11.11 (2012): 1720-1733.

[25] Raniwala, Ashish, KartikGopalan, and Tzi-ckerChiueh. "Centralized channel assignment and routing algorithms for multi-channel wireless mesh networks." ACM SIGMOBILE Mobile Computing and Communications Review 8.2 (2004): 50-65.

[26] Mishra, Arunesh, et al. "Partially overlapped channels not considered harmful." ACM SIGMETRICS Performance Evaluation Review. Vol. 34. No. 1. ACM, 2006.

[27] Liu, Yuting, Ramachandran Venkatesan, and Cheng Li. "Load-Aware channel assignment

exploiting partially overlapping channels for wireless mesh networks." Global Telecommunications Conference (GLOBECOM 2010), 2010 IEEE. IEEE, 2010.

[28] Mukherjee, Sreetama, and Sasthi C. Ghosh. "Throughput improvement using partially overlapping channels in WLAN with heterogeneous clients." International Conference on Wired/Wireless Internet Communication. Springer, Cham, 2016.

[29] Gong, Dawei, Miao Zhao, and Yuanyuan Yang. "Channel assignment in multi-rate 802.11 n WLANs." Wireless Communications and Networking Conference (WCNC), 2013 IEEE. IEEE, 2013.

[30] Cui, Yong, Wei Li, and Xiuzhen Cheng. "Partially overlapping channel assignment based on "node orthogonality" for 802.11 wireless networks." INFOCOM, 2011 Proceedings IEEE. IEEE, 2011.

[31] Bejerano, Yigal, Seung-Jae Han, and Li Li. "Fairness and load balancing in wireless LANs using association control." IEEE/ACM Transactions on Networking (TON) 15.3 (2007): 560-573.

[32] Raniwala, Ashish, and Tzi-ckerChiueh. "Architecture and algorithms for an IEEE 802.11-based multi-channel wireless mesh network." INFOCOM 2005. 24th Annual Joint Conference of the IEEE Computer and Communications Societies. Proceedings IEEE. Vol. 3. IEEE, 2005.

[33] Sarada, M &Damodaram, A. (2017). Optimal Channel Allocation with Idle Time Usage (OCA-ITU): Adaptive channel scheduling strategy for 802.11 based Wireless Local Area Networks. ARPN Journal of Engineering and Applied Sciences. 12. 2838-2843.

[34] https://www.rohdeschwarz.com/in/applications/wlan-connection-establishment-application-note_56280-187257.html (accessed on 20th Oct 2017)

[35] P. Latkoski, T. Janevski and B. Popovski, "Modelling and simulation of IEEE 802.11a wireless local area networks using SDL," MELECON 2006 - 2006 IEEE Mediterranean Electro Technical Conference, Malaga, 2006, pp. 680-683.

[36] Pandey, Prateek, and Sasthi C. Ghosh. "Improving throughput and user fairness through priority scheduling in WLAN." Information Networking (ICOIN), 2017 International Conference on. IEEE, 2017.