QoS Enhancements for Video Transmission over High Throughput WLAN: A Survey

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Abstract - **Providing the need of wireless infrastructure IEEE 802.11 WLAN standards are widely used to satisfy the multimedia application over wireless technologies. Delivery of video with increasing saturated traffic over legacy WLAN standards dissembles the performance by being not compatible with the resources. Aiming to this high throughput standard has developed known as IEEE 802.11n with ideal data rate upto 600 Mbps. However the delivery of the video stream over IEEE 802.11n standard is a challenging task due to scalable video properties and adaptive network resources. In this survey, we present a brief survey of scalable video coding standards and MAC enhancements introduced by the new WLAN standards. Peculiarly we focus on the MAC layer enhancements and recent innovation to boost up the video transmission. Namely we investigate EDCA scheduling and aggregation scheme on video transmission. Finally we conclude with the various authors' recent innovative ideas with their advancements and restriction.**

Keywords: IEEE802.11e EDCA, IEEE802.11n, H.264/SVC, QoS, Aggregation.

I. INTRODUCTION

With tremendously increasing the usage of multimedia application over wireless technologies, the family of IEEE802.11 Wireless Local Area Network (WLAN) standards has become the actual stipulation for providing various wireless infrastructures to offer permeating mobile internet connections. Today approximately all public and enterprise sites, such as offices, airports, educational campus, bus and train stations, hot spots, public area and home application has been deployed with IEEE802.11 WLANs. Various new applications are expanding the emerging multimedia services over WLAN, from conventional VoIP and video delivery to online mobile gaming and video conferencing. In next generation, the new wireless standards, enabled with more powerful processing capabilities and adaptive in nature according to the surrounding scenario than the legacy wireless access point, are expected to provide in demand Quality of Services (QoS) for high definition video delivery to High Definition Television (HDTV) terminals. The popularity of Wi-Fi access functionality equipped smart phones has led to in image and video centric applications, enabling video calling and real-time camera video content sharing. To accomplish the above future applications, the significant percentage of mobile video services will be delivered over the IEEE802.11 WLANs. However video streaming over WLANs is still a challenging task, particularly when these services need to desired guaranteed QoS for their applications. The main problem faces by WLANs standards is the wireless channel is dynamic and error-prone and video data packet transmission over wireless channel is both error sensitive and time critical. The new scalable video compression algorithms trying to achieve adaptive bandwidth reduction creates complex dependencies among video sequences. During the video transmissions over WLAN, video frame errors or delay losses affects on the current video frame and also the predecessor video frames. The delay of video data packet transmission needs to be kept within threshold value to be got recognized. The threshold value is decided by the frame decoding video standards at the receiver, demanding the real time transmission a full-bodied approach must be there to ascertain time varying dependencies of video packets. A video packet must be received at the receiver before the delay threshold value then after it is useless and creates the congestion in network resources. Thus two running afoul in video over WLAN i.e. error and delay dependencies of video packets , has been the source of inspiration for developing and enhancing new enhancements at MAC layer of WLAN standards for video transmission over wireless standards to guarantee desired on demand quality of service.

Over the past few years, substantial advances have been reported for video transmission over WLAN. These advances are mainly at PHY or MAC layer of the standards. The IEEE802.11 standards have been continuously evaluating to support the multimedia application and real time application. The first WLAN standard was standardized in 1997 with the ideal data rate of only 2 Mb/s. The most recent standard, IEEE802.11n was standardized in 2009 with goal to achieve ideally high data rate of up to 600 Mb/s owing to the new high throughput WLAN transmission technology [16]. The continuously increasing Physical layer (PHY) promises enough bandwidth to support such high capacity transmission for video streams. Along with PHY layer amendments we also need to cautiously design innovative schemes for Media Access Control layer (MAC), error recovery and channel access mechanism to ensure smooth video delivery over WLANs. The two amendment standards IEEE802.11e and IEEE802.11n have been dedicated to improve the efficiency of video data transmission in the MAC layer. The IEEE802.11e specifies a new Distributed coordination function known as EDCA [8] where a set of higher priority channel access for video stream category is used to reduce the transmission delay while the IEEE802.11n specifies a new aggregation, block acknowledgment and reverse direction enhancements for high throughput broadcasting over WLANs [17]. Besides these PHY and MAC layer mechanisms specified in the standard, there are numerous mechanisms have been explicated to improve the performance of video transmission over WLANs, including video slice admission control, application layer control, cross layer optimization, aggregation and much more. Among all these, the cross layer technology and aggregation scheme is the most demanding schemes to overcome the inherent problems of video transmission over wireless channels. In this survey paper, we bring out and summarize several relevant technologies for video over WLANs. We classified the technologies based on their implementation within the respective WLAN standards. For the convenience in Section II, a brief review of scalable video compression and streaming techniques is introduced. In Section III, IEEE 802.11e standard and its enhancements for video delivery over WLANs, is presented. In Section IV, IEEE 802.11n standard and its enhancements for better network performance is presented. We discuss several important issues and enhancements of video over IEEE 802.11n WLANs in Section V. In section VI the open key issues related to video over WLANs are discussed and concludes the paper with summary in section VII.

II. H.264/SVC INTRODUCTION

An industrial video compression standard such as H.264/MPEG10 or advance video coding (AVC) converts digital video into formats that aims less capacity for transmission or for storage. The limitation of scalability restricts the ability of H.264/AVC to meet different needs of different users with different displays connected through different networks links. Some of the H.264/AVC examples such as video conferencing, video playback, video surveillance and video recording are affected due to saturated traffic. Therefore Joint video team of ITU-T VCEG and the ISO/IEC MPEG -2007 proposed H.264 scalable video coding (SVC) standards.

SVC stands for scalable video coding where scalable means to remove of parts of the video bit stream in order to adopt it to the various needs for preferences of end user as well as to varying terminal capabilities or network connections[1]. Scalable encoding of video data enables a decoder to decode selective part of the coded bit stream according to the dynamic bandwidth adaption. The encoded coded stream is arranged in a number of layers, including a single base layer and multiple enhancement layers as shown in figure 1:

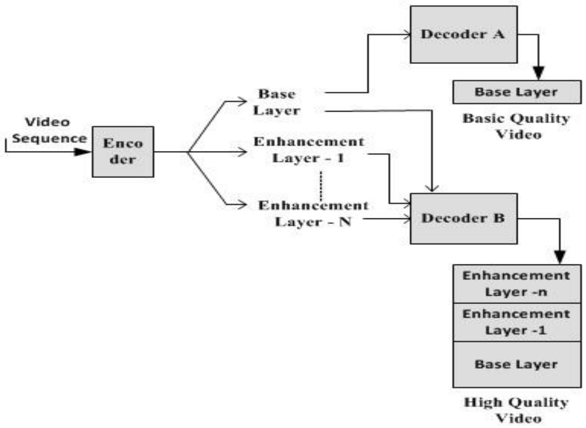

Figure 1: Scalable Video Coding basic principle.

In the figure 1, decoder A receives only the base layer codec stream and can decode only a basic quality version of the video scene, whereas decoder B receives all enhancement layers together with base layers and decodes a high quality video. This property has an advantage over number of applications, for example, a low-complexity decoder may only be capable of decoding the base layer and a reduced bit stream rate (containing only Base layer information) may be drew out for transmission over a network with limited bandwidth capacity or limited resources. The new features of H.264/SVC are temporal, spatial and quality scalability [2]. In temporal scalability subset of the bit stream represents the source content with reduced frame rate. In spatial scalability subset of the bit stream represents the source content with reduced picture size. In quality Scalability the sub stream provides the same spatial temporal resolution as the complete bit stream, but with lower signal-to-noise ratio (SNR). H.264/SVC is comprises of one base layer and one or multiple number of enhancement layers. Among them he base layer provides the introductory video Quality. For backward compatible, the base layer must is to be recognized by all conventional H.264 decoders which make it compatible with its legacy standards. Video quality is gained by adding the enhancements layer with the base layer. On the other hand during due to saturated traffic or noisy environment which makes bandwidth availability insufficient, dropping one or more enhancement layers is done to avoid run-time blocking off [4][5].

III. IEEE 802.11e EDCA

IEEE 802.11e EDCA is designed with aim to enhance the 802.11 Distributed Coordination Function by providing a staggered access method that can support service differentiation among different classes of traffic.[8] EDCA classifies the incoming traffic into four different access categories as illustrated in figure 2. The four access categories is comprise of AC_VO (for voice traffic), AC_VI (for video traffic), AC_BE (for best effort traffic), and AC_BK (for background traffic).

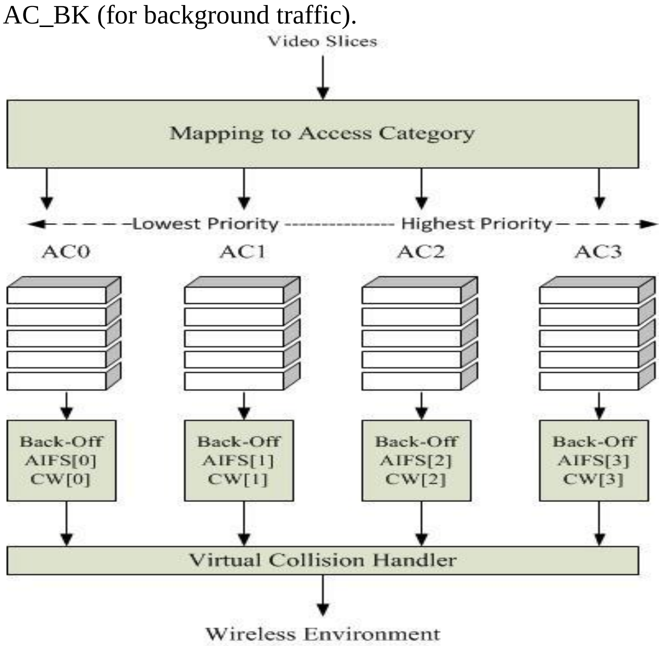

Figure 2: Four access categories in IEEE 802.11e

Each AC has its own buffered queue and bears as an autonomous back off entity. The priority among ACs is determined by AC-particular parameters, called the EDCA parameter set. The EDCA parameter set includes maximum Contention Window size (CWmax), minimum Contention Window size (CWmin), Transmission Opportunity limit (TXOPlimit) and Arbitration Inter Frame Space (AIFS). The preferred values of each parameters that the standard recommends are shown in Table I. [11 ,12]

Access Category	AIFSN	CW_{min}	CW_{max}
AC 3	2	7	15
AC 2	2	15	31
AC 1	3	31	1023
AC 0	7	31	1023

TABLE I: IEEE802.11E MAC PROTOCOL PARAMETERS

To achieve distinction, EDCA assigns higher priority ACs with smaller CWmin, CWmax, and AIFS to regulate the successful transmission probability in favor of high-priority ACs instead of using fixed DIFS (Distributed Interframe Space) (as in 802.11 DCF). The AC with the smallest value of AIFS has the highest priority, and a station needs to postpone for its corresponding AIFS interval. The smaller the parameter values (such as AIFS, CWmin and CWmax) the greater the probability of acquiring access to the medium [12]. Each access category within a station behaves like an individual virtual station; it competes for access to the medium and independently starts its backoff procedure after detecting the channel being idle for at an AIFS period. The backoff procedure of each access category is the same as that of DCF. When a collision occurs among different ACs within the same station, the higher priority AC is allowed the chance to transmit, while the lower priority AC suffers from a virtual collision, similar to a collision outside the station. IEEE 802.11e EDCA determines a TXOPlimit as the time interval during which a particular station can originate transmissions. During this period, i.e. from starting time to maximum duration, stations are allowed to transmit multiple data frames from the same AC continuously within the time limit defined by TXOPlimit. In 802.11e EDCA the higher priority ACs have a longer TXOPlimit, while lower priority ACs have a shorter TXOPlimit. Priority distinction used by EDCA assures better service to high priority class while offering a minimum service for low priority traffic. Although this mechanism improves the quality of service during real-time traffic, the performance incurred is not optimum since EDCA parameters cannot be adapted according to the network conditions.

In [9] author suggest two mechanisms; one is adaptive video prioritization which works according to video frame priorities and MAC layer adaptive prioritization which works on estimation of the delay time of each access category (AC). In the suggested technique video frame is prioritized according to its importance in group of pictures GOP. Prioritization is done on the basis of average measured PSNR and they are then sorted. Top one third prioritized frames is assigned priority 1, middle one third prioritized frame is assigned priority 2 and last one third prioritized frame is assigned priority 3. These frames are passing to MAC layer where MAC layer adaptive prioritization algorithm is used. Here priority 1 packets will go to AC[3] and AC[2] only , priority 2 packets can go to AC[2] or AC[1] and AC[0] where as priority 3 packets can go to AC[1] or AC[2].In the suggested technique delay may occur in heavy loaded traffic due to prioritization process and sorting of video packets. Even if anyone of the AC Queue will get overflow the respective prioritized packet will be dropped out. There is no mechanism shown hoe to switch between respective accesses categories.

Cross layer architecture is proposed in [10] in which each slice of video frame is given priority. Slice ‘I’ and slice ‘P’ is given a priority 3, slice ‘B’ is given a priority 2 and slice ‘PB’ is given priority 1. Here slice ‘I’ and slice ‘P’ is directly mapped to AC[2], slice ‘B’ are mapped to AC[1] and slice ‘PB’ are mapped to AC[0]. Thus static mapping concept is used i.e. each slice has fixed access category to go through. A consideration is required if AC[2] gets overflow, base layer slices will be discard which are non discard able for retrieving of video. In presence of best effort traffic or background traffic, slice ‘B’ and slice ‘PB’ will get affected or may be dropped out even if AC[2] has less load.

In [11] a cross layer rate control scheme for optimizing 3D wavelet scalable video has been discovered. The approach is based on bandwidth estimation and video packets classification. In their proposed method they insert less traffic to AC[2] with respect to AC[1]. They classify the important frame form a group of picture and mapped it to AC[2]. According to authors they are expected that under heavy load conditions overflows is likely to occur in Ac[1] thus saving the important frame in access category -2.Authors doesn’t give explanation which frame will mapped to in AC[2] and AC[1].According to them more traffic will be mapped to AC[1] which can lead to buffer out problem at AC[1] even if AC[0] is free or AC[2] is capable of handling traffic.

In [12] authors proposed an adaptive cross layer mapping algorithm for MPEG-4 video transmission. Here an author follows the dynamic mapping of the video packets. In the suggested algorithm incoming video traffic goes to AC[2] till queue length reaches to the its upper threshold value. After reaching it upper threshold value, according to the frame type and remaining queue length it will be mapped to AC[1] or AC[0]. All the decision is made on the basis of remaining queue length. Till upper_threshold value all traffic is mapped to AC[2] therefore there is a chance of blocking up of queue when traffic is heavily loaded. Even if AC[2] is partially filled there is a chance of important frames to be mapped to AC[1] because decision is also taken on account of random number. There is no checking mechanism of AC[1] that is what to do if AC[1] is also gets to be overflow.

A cross layer optimization through SVC packet prioritization at the application layer and service differentiation at the MAC layer is suggested in [14]. Here the author has derived the mathematical model through which a look up table of R(N) which denotes the ratio of normalized throughput between AC[2] and AC[1]. According to this graph the packets are mapped to the desired categories. This method is acceptable in non saturated traffic. For heavily traffic video packets may drops even if AC[0] is free. Importance of video slice is not consider, according to the look up table slice–I, slice-B and slice-P are mapped to AC[2] or AC[1].

Authors investigate a mathematical analysis on role of aggregation with fragment retransmission on IEEE 802.11e WLAN standard in [15].In this scheme only corrupted frames are re transmitted which reduces the overheads, it leads to the better network throughput. Here they assume for the frame aggregation in IEEE 802.11e but doesn't show they will aggregate the frames. If the concept of aggregation with fragment retransmission is implemented then there will be gibing problem with the legacy standards.

IV. IEEE 802.11n WLAN STANDARD

With increasing the utilization of multimedia application over wireless network technologies there is need of a standard to provide high data rate to provide better QoS and network performance. Keeping the above as goal IEEE 802.11n was developed to reach ideally 600 Mbps [16]. Although legacy device 802.11e supports the QoS, Transmission opportunity and enhanced distributed coordination function, the inefficiency of channel utilization in legacy 802.11 MAC is not fulminate. To gratify the need of the high-speed wireless network access, the major amendment of IEEE 802.11n is done in PHY layer and MAC enhancements. The use of MIMO in PHY layer provides many benefits, such as increases the spectral efficiency of a wireless communication system. By using multiple antennas, a development of the multipath processes can leads to the data throughput and range increases, and the bit error rate decreases. Another important amendment in PHY layer enhances the bandwidth of the current channel from 20 MHz to 40 MHz, using a wider channel bandwidth will improve the network efficiency. The major MAC layer enhancements in 802.11n are aggregation, block acknowledgement, and reverse direction.[17]

IV.a Aggregation:

The aggregation scheme in 802.11n is designed as two-level aggregation scheme. These two types of aggregation frame are: aggregate MAC protocol service unit (A-MSDU) and aggregate MAC protocol data unit (A-MPDU)[20]. The aggregation scheme can be considered with single A-MPDU or A-MSDU, or using both of them to design two-level aggregation. A-MSDU is created with multiple MSDUs which are received at the MAC layer as shown in figure 3.

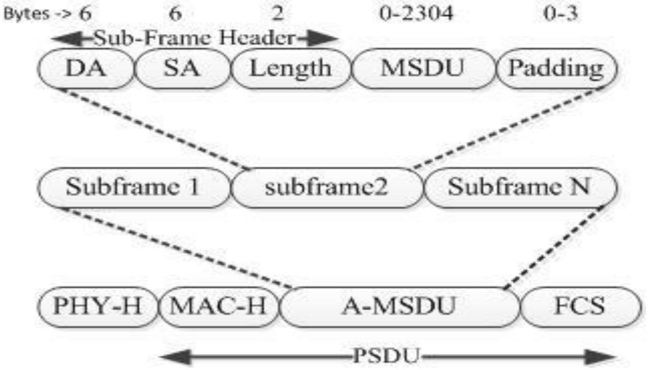

Figure 3: A-MSDU aggregation scheme.

By default the aggregation frame of IEEE 802.11n is of 7935 bytes. Broadcasting and multicasting packets are excluded. In the second level, multiple MPDUs are aggregated into an A-MPDU as shown in figure 4.

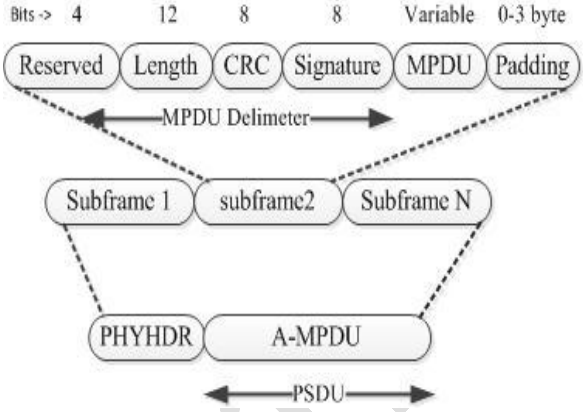

Figure 4: A-MPDU aggregation scheme.

A-MPDUs are created before sending to PHY layer for transmission. Unlike the AMSDU creation, MAC does not wait for additional time before the A-MPDU aggregation. MAC only uses the MPDUs already in the queue upon creating AMPDUs. The A-MSDU aggregation is only applicable for packets having the same source and destination. For each A-MPDU, every MPDU sub frame includes an MPDU frame, the MPDU delimiter and the padding bytes. The maximum frame size limit of A-MPDU is 65535 bytes. Delimiter field is used to separate MPDU sub frame in an A-MPDU. The de-aggregation process first assures the CRC integrity and on passing the CRC check, the MPDU will be getting de-aggregated and sent to upper layer.

IV.b Block Acknowledgment (Block ACK):

The block ACK mechanism is enhanced in 802.11n for the better application of aggregation in the wireless environment having high bit error rate [17]. There is high probability of error for a large frame therefore to overcome the need of more retransmission, therefore Block ACK is modified to support single or multiple MPDUs in a A-MPDU. When an A-MPDU is received by a station and some errors is detected for some numbers of MPDU, the receiver node send the Block ACK for only those MPDUs who gets correctly. Thus sender has to re transmit only those MPDUs who get errors (non ACK MPDUs) while getting receiving. Block ACK mechanism is applicable to A-MPDU, not to A-MSDU. As said if a MSDU is found to be faulty, the whole A-MSDU needs to be retransmitted for error recovery. The maximum limit of MPDUs in an A-MPDU is 64 so one block ACK bitmap can acknowledge at most 64.

IV.c Reverse Direction:

In legacy standards the transmission is unidirectional for the station holding TXOP in the conventional TXOP operation. This mechanism is not suited for bi-directional traffic scenario such as VoIP, gaming, video telephony. Therefore for better QoS support in real time application TXOP must provide forward direction transmission as well as reverse direction transmission. The new reverse direction mechanism allows the station holder of TXOP to allocate its unused TXOP time to its receivers for better enhancement of the channel utilization. The reverse direction mechanism is mainly enhanced to reduce the delay time in reverse link traffic. Reverse direction data packets can be transmitted immediately whenever the RD responder is given the leftover TXOP.

In [17] authors examine the new 802.11n MAC layer enhancements such as aggregation, Block Acknowledgment and reverse directions. Here author discuss the problem of larger frame aggregation which will reduce the overhead but in high bit-error rate wireless environment it will have higher probability of collision which leads to more retransmission and network performances degradations. A-MPDU is better aggregation scheme rather than A-MSDU because if one of MPDU frame is not received then only that frame has to be retransmitted but in MSDU if any one frame is not received correctly, whole A-MSDU has to be retransmitted. Author has list the advantage of reverse direction mode in reducing the delay time in reverse link traffic. This method is best suitable for voice application but it may degrade the performance during video transmission. Through simulations results author has suggested to keep aggregation size 16383 bytes for better performance.

In [18] author shows that A-MPDU is better than A-MSDU and also suggests a new proposed aggregation scheme mA-MSDU that reduces the aggregation headers by studying the role of the aggregation header on the aggregation mechanism. A-MSDU frame is limited to a maximum of 8Kb.A-MSDU has better performance with respect to A-MSDU in clear channel with same aggregation environment. From mathematical analysis they show that header to data payload ratio is inversely proportional to MSDU size, it is approximately constant or large MSDU thus there is scope of reducing MSDU headers payload. Similarly with their analysis shows that header to data payload ratio is constant and there is negligible scope in reducing A-MPDU headers.

The frame aggregation scheduler which aggregates the frame on the estimated deadline time for frame transmission is suggested in [19]. The proposed algorithm also dynamically chooses the type of aggregation scheme according to the availability of resources. According to the author large number of frames leads to an increased delay which has been shown through their simulations which can leads to the delay.

The performance analyses of A-MSDU, A-MPDU and two level aggregations are carried out in [20]. Their simulation results shows that small packets size is responsible to lower down the network performance whereas A-MPDU increase the network efficiency from 3 to 4 times. But in noisy environment short packets are preferable for beneficial retransmission because the processing times need to aggregate frame can increase the overall delay. Thus a type of dynamic aggregation scheduler is needed to support both clear and noisy environment. In [21] author through analytical model shows that the mandatory and real time PHY rate has different performance because of fixed MAC overheads which has larger fraction of the channel access. With the help of their simulation results they conclude that UDP traffic has higher channel utilization than TCP traffic. They conclude that multimedia transmission must be done through UDP traffic.

In [22] authors design a new frame aggregation scheme where incoming traffic is distinguished with their QoS requirement. Here distinguished traffic class has been assigned with the traffic class has been assigned with the weight factor according to which their packets get aggregated. Author's perspective to aggregation threshold is that it can be of Aggregation delay or due to frame length threshold. The later one is decided according to the QoS requirement such as or video it may be set to 150 msec and for frame length threshold it is decided through MTU of the physical layer protocol. A delay may occur in this approach due to recursively calculation of scheduling weight actor. A traffic class of less important requirement may get lost while aggregating higher priority traffic class.

A novel mechanism of dynamic frame aggregation where aggregation depends on transmission rate using the received ACK signal strength is designed in [23]. Here MAC scheduler looks up in table (transmission matching table) for selecting the optimal frame size .For every frame transmission, it has to look up in the table which leads to undesirable delay.

V. REVIEW of VIDEO OVER IEEE 802.11N WLAN STANDARD

In this section we carried out the survey of various strategies and innovative ideas for MAC enhancements to deliver video over WLAN with desired quality of service. In [24] author studied the effect of A-MSDU and A-MPDU aggregation mechanism to support transmission of scalable video streaming over IEEE 802.11n.According to the author the video packets which gets delay greater then 200ms are dropped out. Their simulation results shoes that for aggregation scheme the best suitable maximum retry limit (max retransmission) is 4. Their observation shows that as load increase network performance through A-MSDU is first affected and then to A-MPDU.

A point to multipoint aggregation scheme is suggested in [25]. The entire frame aggregated with an A-MPDU is destined to the same receiver station, but in their approach they aggregate the different frames belong to the different destination. The main aim is to transmit the video sequences simultaneously by inter stream aggregation. Here author notice that aggregation schemes get distracted as video stream increases. The limitation of this algorithm is in heavy load delay will occur due to extensive aggregation time required. Lacks of isolation between inter stream flows at MAC layer.

H.264 scalable video coding streaming evaluation framework (SVEF) for experimental analysis has been suggested in [26]. Here author extends the JSVM open source software of H.264/SVC released by MPEG/ITU Joint Video Team to develop SVEF. Author gives brief description about their framework that how it adapts according to wireless environment and drops the enhancements layers. This framework is used by numerous authors for their analysis of scalable video transmission.

In [27] authors derived mathematical analysis for the performances study of IEEE 802.11n enhanced MAC features. They suggest a queue utilization ratio i.e. traffic arrival rate / frame service rate to determine the multimedia performance over WLAN. According to them for better network performance this ration must be less than one. To grasp the ration less than one aggregation scheme is best suitable which has been proved through simulation results. Author also suggests piggyback aggregation frame transmission which allows bi-direction transmission. But the bi-directional transmission is of no use till there is traffic to transmit in reverse direction.

Study of the performances of video streaming over IEEE 802.11n insight airplane is carried out in [28]. Mainly aggregation scheme is consider for better QoS requirements. According to their mathematical analysis there is more retransmission probability of A-MSDU then A-MPDU. Experimentally A-MPDU frame aggregation outperforms better than A-MPDU.As per author results as aggregation size increase (max up to 65535) number of video connection also increase up to 39 connections. Here analysis is done in ideal condition, if it is done saturated environment number of video connections will get reduced.

In [29] author analyse the performance of ultra high definition video transmission over IEEE 802.11n WLAN. For doing this they compressed UHDTV through H.264 standards. Through experimental and simulation results they proves that sub sampling (4:2:0) with frame rate (fps) 24 furnishes the best result. In comparison to 4:2:2 sub sampling above configuration provides better results in network delay and packet loss. IEEE 802.11n supports aggregation upto 65535 bytes but here author kept MTU size only upto 1500 bytes thus the consequence of aggregation can be evaluate to see network performance.

A new cross-layer optimization strategy of HDTV transmission over IEEE 802.11n has been evaluated in [30]. In their approach they dynamically choose the quantization parameter at video coding layer and modulation and coding process at PHY layer. First they find out the BER value for each MCS and then a frame is divided into many time slots each having a sample of the adding and according to it that quantization parameter and MCS is adapted which increase the PSNR value of the received video.

In [31] authors' takes subjective test with external participants to study different MAC parameter to comprehended QoE or video performance. Different video types are studied and evaluated on the basis of mean opinion score such as of movie, animation and sports type. Their outcomes are Aggregation with block acknowledgment will have better performance. As bit error rate increase received video quality decease. As the stations increase video quality decrease. Increasing the retransmission limit will increase the performance of video transmission. As queue length increase the video QoE increase and plays more impact on increasing competing station

VI. OPEN KEY ISSUES

In this paper we have shown various QoS related problems in video transmission over WLAN standards. To achieve high network efficiency an enhanced DCF in IEEE 802.11e and aggregation in IEEE 802.11n has been introduced. As this enhancements are better than legacy standards but there is more scope of enhancements which always been a hot research topic for the researchers. Some of the IEEE 802.11e EDCA enhancement is shown in table II. IEEE 802.11n MAC enhancement analysis is compared in table III.

Reference	802.11e Cross Layer	Qos Metric	Comments
[9]	Static mapping	PSNR	Buffering at AC[2] even other AC is free
[10]	Static mapping	PSNR	Slice 'I','B','P' are consider same during dropping out.
[11]	Static mapping	PSNR , Packet loss	No consideration of AC[0]
[12]	Dynamic mapping	PSNR, Queue length	Supports dynamic mapping upto some extents.
[14]	Static mapping	PSNR	Result may degrade in saturated traffic.

TABLE II – COMPARATIVE STUDY OF IEEE 802.11E EDCA

Reference	802.11n Enhancements	Qos Metric	Comments
[17]	Aggregation, BACK, RD	Delay, Throughput	A-MPDU is better than A-MSDU, RD is not suited or video streaming.
[18]	Aggregation at MSDU level	Header to data ratio	Negligible scope or improving A-MPDU
[19]	Aggregation	Delay, Throughput	As traffic increase delay increase due to frame aggregation
[20]	Aggregation	Throughput	Smaller frame can be aggregated in noisy channel.
[21]	Aggregation	Channel utilization	Use UDP to transmit video packets.

TABLE III – COMPARATIVE STUDY OF IEEE 802.11N STANDARD.

In table IV we present a comparative study of different mechanism suggested to transmit video over very high throughput WLAN. In table V common comments by various researchers has been represented.

Reference	Video Standard Used	QoS Metric	Comments
[24]	H.264/SVC	Throughput , Delay	Only analysis has done
[25]	MPG-4	Delay, no. of video stream	Lacks of isolation among inter stream video.
[27]	H.264/MPEG-4	No. of video connection	Bi-direction transmission is not suitable for video.
[28]	Not specified	throughput	Degrades in heavy load.

TABLE IV – COMPARATIVE STUDY OF VIDEO TRANSMISSION OF VIDEO OVER IEEE 802.11N STANDARD.

References	Comments
[1][2][3][5][6][26]	H.264/SVC video coding is better option in saturated traffic.
[18][20][21][24][25]	A-MPDU is better aggregation scheme then A-MSDU
[19][25]	As traffic increase aggregation process degrades the network performance.

TABLE V – COMMON COMMENTS BY SEVERAL AUTHORS.

VII. CONCLUSION

We have provided a brief survey of video transmission over WLAN standards. We focused on the QoS metrics gains based on the cross layer mechanism and frame aggregation. For easy understanding we highlighted the basic overview of H.264/SVC video standards. Their characteristic makes this standard very efficient in time varying network resources. For the video over IEEE 802.11e, most schemes designed are associated with static mapping. From our survey we find that there is a scope of designing righter cross layer solutions. As providing very high throughput, IEEE 802.11n is best standard for supporting video over WLAN. From our survey we concludes that there is a need of better aggregation scheme to guaranteed QoS requirement for video transmission over WLAN standards. Till there is a multimedia application over wireless technologies it will be the area of research to provide better network efficiency and real time quality of service.

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