A Cross Layer Model to Support Qos for Multimedia Applications on Wireless Networks

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Abstract

Supporting multimedia application over wireless networks poses multiple challenges. Currently the use of cross layer architectures and Scalable Video Coding ( ) techniques are considered to support multimedia applications. The current architectures fail to address the tradeoff that exists between the end to end delay and the Quality of Service ( ) provisioning of the video data to be delivered. To address this issue this paper introduces the improvement scheme in video transmission model based on a cross layer architecture. A novel encoding of the SVC video is considered in the proposed model. Based on the physical layer conditions and the achievable the model adapts to meet the stringent delay requirements of video delivery. Routing layer optimization is achieved by accounting for the pending packets queues in every neighboring node. The experimental study conducted prove the robustness of the proposed model by comparing with the existing schemes. Comparisons in terms of the transmission error rates, system utility and quality of reconstruction are presented.

Index terms— scalable video coding (SVC), cross layer, H.264, multimedia, quality of service (QoS), MAC, routing, encoding.

1 Introduction

he increasing demand by of users to access infotainment solutions on wireless networks aid development of novel models to support applications [1] [2]. To support such multimedia application delivery on wireless networks high bandwidth [3], quality of service (??????) [4], stringent delay requirements have to be accounted for. Wireless networks are characterized by limited bandwidth, hop based routing and error prone nature. This nature tends to induce transmission loss, delayed delivery and high jitter in supporting video streaming applications [5] [6]. The ??????/?????? ???????? [7] group and the ?????? ? ?? ???????? **??**8] groups have standardized the Scalable Video Coding (??????) extension to the existing ??. 264video compression standard which can be adopted to support multimedia applications on wireless networks [9]. The ?????? compression technique enables video encoding taking into account the varied quality, spatial and temporal parameters, thus providing adaptability. Considering wireless networks based on the network conditions, network configuration, application demands and ?????? parameters the ?????? video encoding can be adopted to support multimedia transmissions.

Adoption of the ?????? for multimedia data delivery on wireless networks cannot be considered as a holistic solution. . Video transmissions are delay bound and delivery of the data packets within the delay deadlines is of most importance [1] [5] [11] [14]. The multimedia data delivery is achieved through hop based mechanisms in wireless networks. The distortion and the available channel capacity vary during data delivery which needs to be accounted for. The end to end delay varies based on the physical layer condition and the buffering mechanism at the medium access. The transmission errors induced cause packet retransmission overheads. Based on the physical layer conditions the next hop routing mechanism also requires constant updation. In short it can be stated that, delivery of delay sensitive data on wireless networks put forth variations in the physical layer, medium access control layer (??????) and the routing layer. Apart from these variations observed it is also critical to establish a balance between the data delivery and the ?????? provided. Providing ?????? at the cost of delayed data delivery is ineffective in the case of multimedia data [1] [14]. To address these issues researchers have proposed a cross layer architectures to account for the dynamics observed at the physical, ?????? and routing layer for multimedia data [3] [12] [13] [14]. Combining cross layer optimization and ?????? encoding for multimedia data delivery has been considered in [11], [15] and the results obtained prove the efficiency and assure ?????? provisioning.

The existing models fail to address the tradeoff relation that exist between the ?????? of the ?????? encoded data transmission and end to delay i.e. if the ?????? to be provisioned is high the end to end delays are high proved in [14]. To address this issue this paper introduces the ?????? improvement scheme in video transmission (??????????) model adopting a cross layer optimization approach. The ?????????? model considers the ?????? encoded video streams for transmissions. Based on the physical layer conditions of the wireless network, the quality adaptation specifier (?? ??1) and the physical layer knowledge specifier(?? ??2)are identified. A novel encoding scheme of the ?????? video utilizing the ?? ??1 and?? ??2 is considered at the ?????? layer. The packets constructed at the ?????? layer are routed through the next hop node based on the ?? ??1 , ?? ??2 and pending packets in that node. A similar approach is adopted at every intermediate hop node. The ?????????? model proposed is designed to address the tradeoff between ?????? provisioning and delivery of the delay bound multimedia data. The cross layer optimization adopted in the ?????????? model provides adaptability to achieve better ?????? in wireless networks and ensures the essential delay bound multimedia data delivery.

The remaining manuscript is organized as follows. A brief of the literature review discussing the state of the art mechanisms that currently exist is discussed in section 2. The proposed ?????????? model is presented in Section 3 of this paper. The simulation study with performance comparisons is discussed in the penultimate section of this paper. The conclusions and future work is discussed in the Section 5.

2 II.

3 Literature Review

Numerous work considering multimedia data delivery on wireless networks has been proposed by researchers. A brief of the literature studied during the course of the research presented here is discussed in this section.

An ant colony optimization algorithm to support video streaming services on wireless mobile networks is proposed in [3]. A dual layer architecture constituting of the mini-community network layer and the community member layer is considered in [3]. The mini-community layer enables robust video data delivery and access methodologies.

The resource and member management is achieved by the community member layer. The results presented prove the efficiency of the biologically inspired ant colony optimization.

A cross layer optimization technique to support video transmissions on wireless networks has been proposed by Yuanzhang Xiao et al [12]. The importance of resource allocation to support video transmissions is discussed. The cross layer architecture proposed by Yuanzhang Xiao et al enables dynamic scheduling and resource allocations among the wireless user nodes based on the physical channel conditions and the dynamics of video transmissions.

The cross layer fairness driven stream control transmission protocol based concurrent multipath transfer solution (?????? ? ????/????) is proposed in [13]. The efficiency of utilizing multipaths for video content delivery is highlighted. Optimizations were adopted at the physical, data link and transport layer in the ?????? ? ????/???? to support video applications on heterogeneous wireless networks. In ?????? ? ????/???? the cross layer optimization is adopted only at the transmitter.

Hypertext Transfer Protocol (????????) based Dynamic Adaptive Streaming (????????) of ?????? video in wireless networks is discussed in [11]. A cross layer optimization based on the Lagrangian method is adopted in ??????? to support streaming of ?????? video. A novel resource allocation and packet scheduling exists between data delivery and ?????? of video transmissions is discussed. The tradeoff issue is addressed by Mincheng Zhao et al through a proxy based bitrate stabilization algorithm introduced in ????????.

Transmission of ?????? video data in multi input multi output (????????) wireless systems is proposed by Xiang Chen et al [15]. A cross layer approach adopting optimizations based on the physical and application layer is proposed by Xiang Chen et al. To reduce transmission errors and reduce the number of retransmissions ?????? mechanisms are also employed by the authors in [15]. An adaptive channel power allocation scheme is used in [15] to improve the ?????? of video transmissions. The work proposed by Xiang Chen et al bears the closest similarity to the work proposed here and is further used for performance comparisons with our proposed ?????????? model. The major drawback of the cross layer approach proposed in [15] is that the tradeoff that exists between ?????? provisioning and video data delivery is not addressed.

4 III.

5 ?????? Improvement Scheme in Video

Transmission ?????????? a) Wireless Network Modelling Let us consider a wireless network??deployed over an area of ?? sq.meters. The network ?? consists of a set of ?? nodes sharing the multimedia content ?? with ?? receiver nodes. The channel matrix of the ?? ??? node is represented as?? **??**??] where ?? ? ?? ? ?? . The wireless channel Bandwidth considered is ?? ?? and the channel error rate is represented by ?? ?? . The channel noise is represented as ?? . The ?????? video data [1] is considered as the multimedia content.

Video transmissions are bulky and require efficient transmission mechanisms to meet the desired ??????. In the ?????????? model introduced in this paper the video content is initially encoded using the MPEG video coder. The ???????? video coder considered adopts the Group of Pictures (??????) structure described in [2] [14]. The ?????? structure is shown in Fig. 1. of this paper. In the existing mechanisms discussed earlier a loss of the ???? and ???? frame results in a retransmission enhancing end to end delays and reducing the wireless transmission QoS. To improve the QoS in multimedia content delivery over the network ?? the ?????????? model introduces a novel cross layer adaption technique [3]. By acquiring the prevailing physical layer properties of the node, the MAC layer packetization techniques and the routing to the neighboring nodes are accordingly adapted to achieve a cross layer design discussed in the proceeding sub-section of the paper.

6 b) Cross-Layer Design Of The ??????????model

A discrete time based model to describe the cross layer architecture of the ?????????? model is considered. Let us consider a node ?? ? ?? transmitting content ?? to its neighbor ?? ? ?? . At time ?? ? 2 the ?? frame is transmitted. The ?? ð ?"?ð ?"??1 frame consisting of ?? ð ?"?ð ?"??1 ?? ? and ?? ð ?"?ð ?"??1 ?? ? is transmitted at the (?? ? 1) ??? time instance. In the ??????????model the ??? frame is assumed to consist of two sub-frames namely ???1 and ???2 i.e. ??? = ???1 + ???2 . The sub frame construction is considered to encode the previous ??? frame into the ???1 and transmit it wirelessly to the node ?? at time ?? . The adoption of the sub-framing technique enables reconstruction of the ??? in case of transmission errors. The encoded frame ?? 1 ð ?"?ð ?"? ?? ? ,?? is defined as?? 1 ð ?"?ð ?"? ?? ? ,?? = ?(1 ? ?? ??1)?? ð ?"?ð ?"??1 ?? ? ? + ??? ??1 × ?? ð ?"?ð ?"??1 ?? ? ? (1)

Where ?? ??1 is the Quality layer adaptation specifier introduced in the ?????????? model. Based on the physical layer parameters, the node bandwidth supported, the pending packets in the ?????? queue and channel noise thevalue of ?? ??1 is established on runtime. The quality adaptation specifier is constrained by the set ?? ??1 ? {0,0.1,0.2 ? 1} . The ?? ??1 specifier enables in controlling the quality of the video transmission between the nodes ?? and ?? . Considering ?? ??1 = 1 the best ?????? can be achieved. When ?? ??1 = 0 only the ??? is transmitted resulting in lower quality.

To account for the physical layer conditions in the MAC encoder the Physical Layer Knowledge Specifier ?? ??2 parameter is introduced and is defined as?? ??2 = ?????? ? ?????? = {0, ? 1}**(2)**

By introducing the ?? ??2 parameter the composition of the ???1 and ???2 sub frames is achieved accounting for the physical layer parameters. If ?? ??2 = 0 then ???1 = ??? and ???2 = ? i.e. the physical layer exhibits high distortion and the transmission of the ??? layer is only considered. If ?? ??2 = 1 then ???1 = ??? and ???2 = ? is considered as an ideal condition when the physical channel exhibits no signal distortion hence the entire ??? layer is considered for transmission.

The ?? ??2 and ?? ??1 parameters are derived based on the physical layer measurements carried out at ??? intervals. The channel noise, packet delay and the error rate observed in transmitting the frame ? enables in initialization. The proposed MAC layer encoding can be now defined as( ) E Year 2015

Where ?? 1 ð ?"?ð ?"? ?? ? ,??,?? ??2 represents the ?????? encoded data derived from the previous ?? ð ?"?ð ?"??1 ?? ? and ?? ð ?"?ð ?"??1. ?? ? ,?? ??2 frame to be transmitted.

The MAC encoding is presented in Fig. 2. of this paper. Step 4: Based on the measurements initialize ?? ??2 and ?? ??1

Step 5: Based on ?? the ??? and ??? frame Data is derived.

Step 6: Based on ?? ??2 and ?? ??1 derive ???1 and ???2 and perform MAC encoding using Equation 3.

Step 7: Based on the MAC packet Queues Pending, ?? ??2 and ?? ??1 perform routing optimization to select hop node.

i. Video Distortion in the ?????????? model Transmission over wireless channels induces errors in transmission. The transmission errors result in a huge number of video packet errors and losses. On packet error or loss occurrences, packet retransmission request and response messages are propagated. This phenomena induces huge amounts of overheads and the video packet delivery time increases effecting ??????.

To improve ?????? the cross layer ?????????? model to reduce packet delivery delays is introduced in this paper. The distortion observed at the receiver is proportional to the channel noise. When the channel noise observed is large, the ?????????? adapts to enable successful transmissions compromising ?????? as video data delivery is delay bound. Packets delivered beyond the delay bound possess no significance and are generally dropped. The ?????????? model proposed provides a delicate tradeoff between timely delivery of data packets and ?????? .The encoding at the MAC layer ?? 1 ð ?"?ð ?"? ?? ? ,??,?? ??2 enables recovery of the ??? from the encoded enhancement layer packet in case the base layer packet is lost. The encoding enables to achieve optimal ?????? in noisy environments. In this section the modelling of the packet error probabilities, video frame transmissions, frame reconstruction, frame decoding, frame errors and the distortions observed is discussed.

Let the data ?? to be transmitted using the ?????????? model form ? ?????????? encoded packets. Each packet consists of ?? symbols. The symbols?? need to be transmitted on the wireless Radio Layer Switching mode of ?? (??) through a channel which has an allocated bandwidth based channel rate of?? ??(??) .The additive white gaussian noise present in the wireless channels induces transmission errors. The error rate experienced by the symbol ?? is given by ?? ??(??) ??? ??(??) , ?? (??) ?.

Let us assume that there are ? ?????????? number of video packets formed from the video to be transmitted.In error free envirometts the complete ? ?????????? packets when transmitted will be received, decoding which would form the data ??.In practical envirometts or actual conditions transmission errors occour due to the noise present in the wireless transmission medium. If out of ? ?????????? Packets only packets are transmitted successfully and remaining (? ?????????? ? ?) packets are lost during transmission such that error occurs at the (? + 1)??? packet, the probability of such an occurrence if ? = 0 is??????(?|? ??????????) = ?? ??(??) ??? ??(??) , ?? (??) ?**(4)**

The probability of occurrence during the transmission being active i.e. 0 < ? < ? ?????????? is given by ??????(?|? ??????????) = ? ?1 ? ?? ??(??) ??? ??(??) , ?? (??) ?? × ??? ??(??+1) ??? ??(??+1) , ?? (??+1) ?? ? ??=1 (5) Considering ? = ? ?????????? the error probablity occurance is defined as??????(?|? ??????????) = ? ?1 ? ?? ??(??) ??? ??(??) , ?? (??) ?? ? ?????????? ??=1 (6)

Let us consider at the ?? ??? time the receiver node receives video packets successfully out of the ? ?????????? packets. If ?? ?? represents the number of symbols in the ?? ??? packet, then the cumulative video data available at the receiver i.e. ?? ???? can be computed using?? ???? = ???? ??(??) × ?? ?? ? ? ??=1**(7)**

The ?????????? mod el priorities the delivery of the ??? ensuring the delay constraints are attained. If the ??? encoded packet at the?? ??? time instance i.e. ?? ð ?"?ð ?"? ?? ? is lost then its recovery is possible from the?? 1 ð ?"?ð ?"?+1 ?? ? ,??,?? ??2 encoded packet.

Let the function ????(?? ???? , ?? ??1 , ?? ??2) represent the distortion observed per frame at the receiver post decoding considering all the symbols of the ??? layer, the quality layer adaptation specifier ?? ??1 , the physical layer knowledge specifier ?? ??2 and ?? ???? is the total symbols of the ??? layer. Based on the error probabilities and the distortions of the individual frames the average distortion ???? ????ð ??"ð ??" [(?? ??1 , ?? ??2)]can be computed using???? ????ð ??"ð ??" [(?? ??1 , ?? ??2)] = ????(0, ?? ??1 , ?? ??2)??????(0 | ? ??????????) + ? {????(?? ???? , ?? ??1 , ?? ??2)??????(? | ? ??????????)} ? ?????????? ?=1 (8)

where ????(0, ?? ??1 , ?? ??2) represents the distortion observed with respect to the reference frame?? ð ?"?ð ?"? ?? ? = ?? ð ?"?ð ?"? ? ??? ð ?"?ð ?"? ?? ? ? ?? ð ?"?ð ?"??1 ?? ? ? ? ?? 1 ð ?"?ð ?"? ?? ? ,??,?? ??2**(9)**

Where ?? ð ?"?ð ?"? is the original frame considered at the ?? ??? time instance.

To achieve optimum ?????? the ??? layer is transmitted and the ???1 is encoded at the ?????? layer and transmitted. Let ?? ð ?"?ð ?"? ?? ? 1 represent the ?????? encoded data of ???1 and ?? ð ?"?ð ?"? ?? ? 2 denote the decoded ???1 data at the receiver. In the ?????????? model the packet loss probability of the ??? is assumed to be 0. The frame reconstructed at the decoder at the ?? ??? time instance is defined as?? 2 ð ?"?ð ?"? = ?? ð ?"?ð ?"? ?? ? 2 + ??? ð ?"?ð ?"? ?? ? ? ? ?? ð ?"?ð ?"??1 ?? ? ? + ?? 2 ð ?"?ð ?"? ?? ? ,??,?? ??2**(10)**

where ?? 2 ð ?"?ð ?"? ?? ? ,??,?? ??2 represents the data at the receiver on performing the ?????? layer decoding on the encoded data?? 1 ð ?"?ð ?"? ?? ? ,??,?? ??2 .

The decoded version of ?? 1 ð ?"?ð ?"? ?? ? ,??,?? ??2 at the receiver on the basis of the partially decoded data of the ??? data i.e. ?? 2 ð ?"?ð ?"??1. ?? ? ,?? ??2 is defined as?? 2 ð ?"?ð ?"? ?? ? ,??,?? ??2 = ?(1 ? ?? ??1)?? ð ?"?ð ?"??1 ?? ? ? + ??? ??1 × ?? 2 ð ?"?ð ?"??1. ?? ? ,?? ??2 ? (11)

Utilizing the above definition in Equation 10 we obtain?? 2 ð ?"?ð ?"? = ?? ð ?"?ð ?"? ?? ? 2 + ??? ??1 × ??? 2 ð ?"?ð ?"??1. ?? ? ,?? ??2 ? ?? ð ?"?ð ?"??1 ?? ? ?? + ?? ð ?"?ð ?"? ?? ?**(12)**

where ?? 2 ð ?"?ð ?"??1. ?? ? ,?? ??2 is the partially decoded data of the ??? layer at the (?? ? 1) ??? time instance and is defined as The parameter ?? ??2 controls the composition of the ??? data. In the case when channel noise is present and the channel bandwidth cannot support the transmission of the entire ?? ? layer i.e. 0 < ?? ??1 < 1 and0 < ?? ??2 < 1, a part of the??? 2 is not considered for encoding and transmission and is defined as?? 2 ð ?"?ð ?"??1. ?? ? ,?? ??2 = ?? ð ?"?ð ?"??1 ?? ? 2, ?? ??2 + ??? ð ?"?ð ?"??1 ?? ? ? ?? ð ?"?ð ?"??2 ?? ? ? + ?? 2 ð ?"?ð ?"??1 ?? ? ,??,?? ??2**(13)**

The partially encoded data of the ??? layer i.e. ???1 at the (?? ? 1) ??? time instance is defined as?? ð ?"?ð ?"??1. ?? ? ,?? ??2 = ?? ð ?"?ð ?"??1 ?? ? , ?? ??2 + ??? ð ?"?ð ?"??1 ?? ? ? ?? ð ?"?ð ?"??2 ?? ? ? + ?? 1 ð ?"?ð ?"??1 ?? ? ,??,?? ??2**(14)**

To compute the transmission error the difference between the encoded video frame at the transmitter ?? ð ?"?ð ?"? and the decoded video frame at the receiver ?? 2 ð ?"?ð ?"? is considered and is defined as?? ?? = ?? ð ?"?ð ?"? ? ?? 2 ð ?"?ð ?"? = ?? ð ?"?ð ?"? ?? ? ? ? ?? ð ?"?ð ?"? ?? ? 2 + ?? 1 ð ?"?ð ?"? ?? ? ,??,?? ??2 ? ?? 2 ð ?"?ð ?"? ?? ? ,??,?? ??2**(15)**

Using Equation **??**and Equation 12the error can be simplified as?? ?? = ?? ð ?"?ð ?"? ?? ? ? ? ?? ð ?"?ð ?"? ?? ? 2 + ??? ??1 × ??? ð ?"?ð ?"??1. ?? ? ,?? ??2 ? ?? 2 ð ?"?ð ?"??1 ?? ? ,?? ??2 ?? (16)

Using Equations 13 and equation 14 ??? ð ?"?ð ?"??1. ?? ? ,?? ??2 ? ?? 2 ð ?"?ð ?"??1 ?? ? ,?? ??2 ?cab be represented as??? ð ?"?ð ?"??1. ?? ? ,?? ??2 ? ?? 2 ð ?"?ð ?"??1 ?? ? ,?? ??2 ? = ?? ð ?"?ð ?"??1 ?? ? , ?? ??2 ? ?? ð ?"?ð ?"??1 ?? ? 2, ?? ??2 + ??? ??1 × ??? ð ?"?ð ?"??2 ?? ? ,?? ??2 ? ?? 2 ð ?"?ð ?"??2 ?? ? ,?? ??2 ?? (17)

The distortion of the ?? ??? frame at the receiver post decoding at the at the ?? ??? time instance is computed using???? ?? (????, ?? ??1 , ?? ??2) = ????ð ??"ð ??"[(?? ??) 2]

(18) where???? is the throughputs observed as the receiver post decoding considering all the frames from the

reference frame ? to the ?? ??? frame From equation 18 it can be observed that the transmission errors effect the throughput observed and also induce distortion in video reconstruction at the receiver. The ?????????? model adapts based on the physical layer conditions to minimize the transmission errors by adopting adaptive ?????? encoding and route optimization.

7 IV.

8 Experimental Study

In this section the experimental study conducted to evaluate the performance of the proposed ?????????? model is discussed. The experimental study was conducted using Matlab. The performance of the ?????????? model is compared with the state of art ?????????????????? ????ð ??"ð ??"??????????? -??1 proposed by Xiang Chen et al [15]. Video clips 'City' and 'Stefan' of Common Interchange Format are considered for the experimental study. The video clips 'City' and 'Stefan' are encoded by the reference ?????? codec JSVM (Joint Scalable Video Model). The 'City' video consists of 300 frames and the 'Stefan' video of 90 frames. The frame rate considered for both the videos is 30 frames per second. The ?????? codec considers the ?????? structure.

A wireless network consisting of 15 nodes is considered. The simulation study considers 4 transmitter nodes and 4 receiver nodes. Experiments considering the 'City' and 'Stefan' video were independently conducted. The M-QAM modulation and demodulation schemes were considered in the experimental study. An additive white Gaussian wireless noise channel is considered and the signal to noise ratio 0, 10, 20 and 30 dB is considered. The video transmissions carried out are monitored and the video is reconstructed at the receiver. An average of the monitored values considering 4 transmitters and 4 receivers is presented.

In the prevision section it has been stated that the distortion observed ???? is directly proportional to the transmission errors ?? ?? i.e. ???? ? ?? ?? . The transmission errors observed per frame is represented in terms of the bit error rates (??????) observed for the duration of the simulation. The ?????? observed considering the 90 frames of the "Stefan" video transmitted is shown in Figure 3, 4 and 5. From the figures it is clear that as the channel noise i.e. ?????? increased the distortion increases considering the QIVST model and the ?????????????????? ????ð ??"ð ??"??????????? -??1 . At a ?????? = 30 ???? (in Figure 3) it is observed that the average ?????? considering the ?????????????????? ????ð ??"ð ??"??????????? -??1 is 0.21 and for the ?????????? model is 0.17. When the channel noise induced in the simulation environment is 20 ???? (in Figure **??**) and 10 ???? (in Figure **??**) the proposed ?????????? model based video transmissions achieves a ?????? reduction of 45.7% and 36.99% when compared to the ?????????????????? ????ð ??"ð ??"??????????? -??1 . Based on the BER results it is evident that the proposed QIVST model is adaptive and performs better than the existing the ?????????????????? ????ð ??"ð ??"??????????? -??1 under varying channel noise conditions. Lower ??????'?? observed tend to enhance the ?????? provided to multimedia data delivery over wireless networks. From equation 18 it can be observed that the transmission errors effect the throughput observed and also induce distortion in video reconstruction at the receiver. The ?????????? model adapts based on the physical layer conditions to minimize the transmission errors by adopting adaptive ?????? encoding and route optimization.

9 Global

In [15] the authors have introduced the "System utility" parameter for performance evaluation. Considering the ?????? of video "Stefan" the system utility computed using the ?????????? model and the ?????????????????? ????ð ??"ð ??"??????????? -??1. The results obtained are graphically shown in Figure **??** of this paper. The system utility increases as the channel noise increases due to transmission errors. The increase in transmission errors induce an additional network overhead by introducing retransmission messages. From the figure it is evident that the proposed ?????????? model exhibits a higher system utility when compared to the the ?????????????????? ????ð ??"ð ??"??????????? -??1 . The adaptive encoding and the cross layer architecture of the QIVST model also contribute to the increased system utility observations. From the reconstruction results considering the "Stefan" video shown in this paper it is clear that the ?????????? model provides better quality in video delivery over wireless networks when compared to the the?????????????????? ????ð ??"ð ??"??????????? -??1. The experimental study presented in this paper prove that the cross layer design based ?????????? model proposed is robust and adaptable proved in terms of lower ??????'?? observed. The ?????????? model induces an additional overhead due to the novel encoding scheme (proved by higher system utility observations) and improves the quality of video transmissions in wireless networks. The results also prove the proposed model superiority when compared to the state of art video delivery algorithm the ?????????????????? ????ð ??"ð ??"??????????? -??1.

High bandwidth requirements, delay sensitive nature and QoS measures of multimedia data delivery on wireless networks put forth numerous challenges. The use of SVC encoded streams on cross layer architectures have been proposed by researchers. The existing mechanisms fail to address the tradeoff between QoS and data delivery delays that exists. In this paper the QIVST model is introduced that adopts a cross layer design. The SVC video data considered in the QIVST model is further encoded at the MAC layer based on the physical layer conditions and the QoS achievable, to address the tradeoff issue highlighted. The distortion observed based on the QIVST model is presented. Based on the pending packet queues observed optimization of the routing layer is considered in the QIVST to minimize the end to end delay. The extensive results presented in the experimental study considering SVC video traces prove the robustness and efficiency of the proposed QIVST model when compared to the state of art existing system. efficient power allocation for H.264/SVC video transmission over a realistic MIMO channel using [1] [2]

1

Figure 1: Figure 1 :

2

Figure 2: Figure 2 :

Figure 3: ©

3

Figure 4: Figure 3 :

45

Figure 5: Figure 4 :Figure 5 :

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Figure 6: Figure 6 1 28Figure 7 :AFigure 8 :

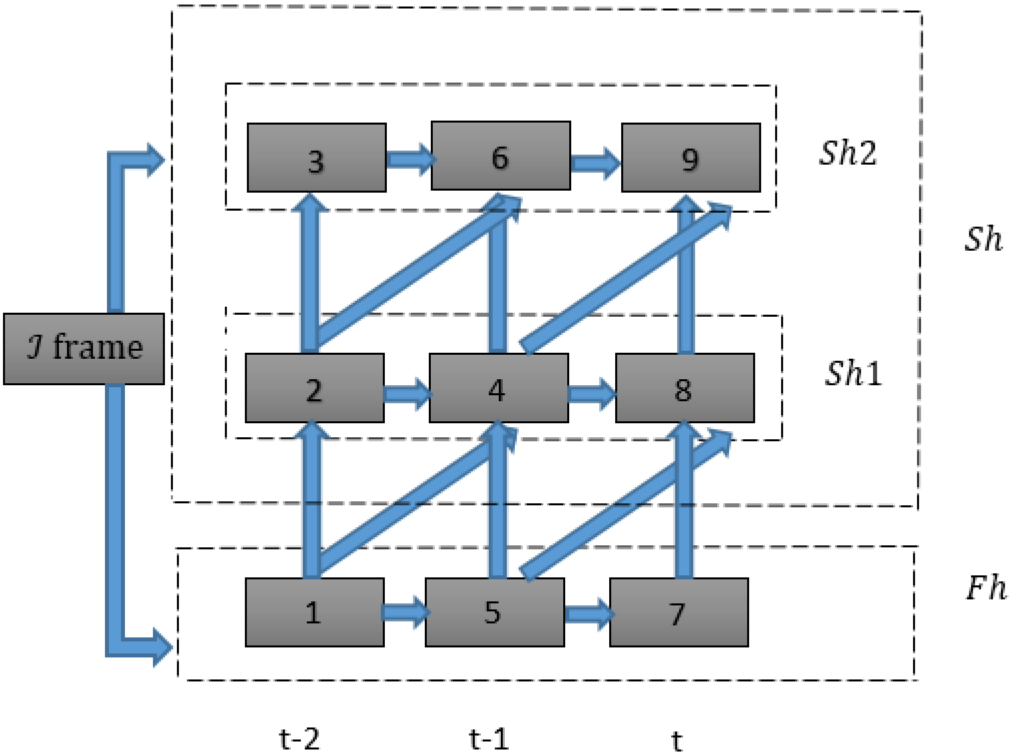

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Figure 7: Figure 9 :

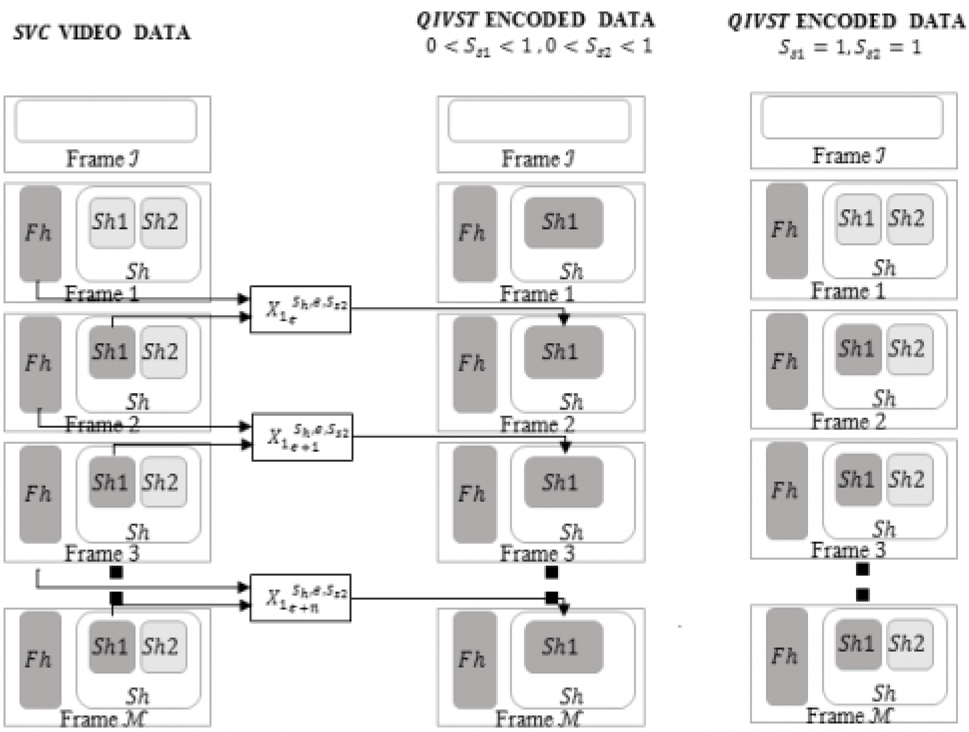

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Figure 8: Figure 10 :Figure 11 :Figure 12 :PSNRA

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