

A RESEARCH ON CROSS LAYER PROTOCOL FOR IMPROVING QUALITY OF MULTIMEDIA TRANSMISSION OVER WIRELESS NETWORK

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ABSTRACT

Transmitting multimedia streams over IEEE 802.11 Wireless Local Area Networks (WLANs) with high performance and reliability is a challenging task. In this paper, we study the basic problems that video transmission in wireless Networks and we present proposed method for solution. The proposed system is compared with Enhanced Distributed Channel Access (EDCA) and Static Mapping approaches using Packet Delivery Ratio (PDR), Peak Signal-to-Noise Ratio (PSNR) and video quality measure (VQM). The main objective of this paper is to propose a new method for enhancing the Quality of Service (QoS) of multimedia applications in wireless adhoc networks. We are using AC (Access Category) and TXOP (Transmit Opportunity) for making change in system parameters. Making change in AC gives better performance for multimedia transmission. Hence, the proposed scheme is compared with static scenarios and it will prove by means of simulation.

Keyword :- PDR, EDCA, VQM, PSNR, AC and TXOP

1. INTRODUCTION

A wireless network is some type of computer network that uses wireless data connections for connecting network nodes. Wireless networking is a technique by which homes, tele-communications networks and enterprise installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. Wireless telecommunications networks are generally enable and administered using radio communication. This implementation takes place at the lowest level (physical layer) of the OSI model network structure.

1.1 Cross Layer protocol

A cross-layer design is used to adjust the transmission rate in transport layer and provide channel information to the MAC layer from the physical layer; resource allocation is determined in the MAC layer according to multi-hop routing information from the network layer. Layers architecture is shown in figure 1

Application Layer (This layer generate multimedia packets and assign priority)
Transport layer (Implement Slow start & TCP/UDP)
Network layer (Implement AODV and DSR algorithms)
MAC layer (Implement EDCA&DCF algorithm)

Figure 1 Layers Architecture

The content in the application layer is passed down to the network layer. When transmitting video, this content is in form of I/P/B frames. Application layer passes this information to lower layers. Depending upon on traffic conditions and priority of the information, the video frames are mapped to different access categories (ACs) by MAC layer. Network layer passes the information about the distance in terms of hop count to MAC Layer. Depending upon this information MAC layer decides whether to map video frames dynamically or send video by single AC

1.2 Quality of Service Parameters

The mobile network Quality of Service (QoS)[1] is defined as “The capability to control traffic handling mechanisms to this network such that the network meets the service needs of certain applications and users subject to network policies”. The Quality of service is used to regulate the resources in applications and the users. In QoS support multimedia applications and real time applications also. Depends on the routing protocol the QoS will be change. Based on the time limit, such as chatting, web applications and so on.

QoS Parameters: To grant QoS, it measures the basic QoS parameters such as Bandwidth, packet Delivery Ratio, Routing overhead, Average end-to-end delay and throughput.

Packet loss :

Packet identifiers give packet losses. They are usually calculated on it. Unique packet id's comes from the network black box. Unique id's can be generated comparatively easy. This is not a problem for simulations. IP provides unique packet id in measurements. To reduce the effect of reordering, unique packet id is used. It is important and interesting to know that data on packets in video transmission. There are 3 types of frames in video format: I, P, B.

Peak Signal-to-Noise Ratio (PSNR):

There are sender and receiver. From the comparison of sender side YUV video and receiver side YUV video we can find PSNR. The receiver receive the video is decomposed by MPEG-4 codec files. So, there are some information is lost. Due to encoder and decoder some redundant information will be lost naturally. PSNR is the basic metric which done comparison frame by frame. The value of PSNR is declared in dB (decibels). For a video to be considered of good quality, it should have an average PSNR of at least 30dB.

Video Quality Measure (VQM):

The VQM metric measures the “perception damage” the video has experienced, by drawing on the Human Visual System (HVS) characteristics, including distinct metric factors such as blurring, noise, color distortion and distortion blocks. VQM obtains values between 1 and 5. Here, 1 (one) represents high video quality and 5 (five) represents low video quality. Means the closer the metric gets to 1, the better the video quality.

1.3 Objective

The main objective of this thesis is improving quality of video transmission over adhoc network. To improve the quality of video transmission, there are many quality parameters like PDR, PSNR, etc. Through the proposed method, I will try to improve Quality of video/audio data transmission over adhoc network.

2. PROPOSED SYSTEM

The IEEE 802.11n standard is the most recent WLAN technology that can operate in both 2.4 GHz and 5 GHz band. It brings multiple technological enhancements to improve speed, reliability and range. For video traffic, the significance of the encoded video data varies. The priority transmission of hierarchical coding video is expected to play an important role in supporting multimedia service in a wireless network. However, 802.11e provides QoS through traffic distribution where all video data in the same access category.

First of all there are four types of AC's. corresponding to voice, video, best effort, and background traffic. Here we named AC0, AC1, AC2 and AC3. AC0 is for back ground traffic. AC1 is for audio frames, AC2 is for B frames and AC3 is for I,P frames.

Three types of video frames:

1. I frame
2. P frame
3. B frame

Concept:

Provides an efficient method for multimedia transmission over adhoc network. Based on IEEE 802.11 , there are four AC's are used. According to IEEE 802.11, Video frames and audio frames sending separately to AC's. Our concept is that to making new method with changing that approach. Changing in transmission of most important I-frame first. Here I frame having most important part of Video so we have to sent this frame before end of transmission. With the use of AC and TXOP , we will get new mechanism. Increasing TXOP for non-reaching frames and restoring if for appropriate AC's. Applying three conditions,

1. AC(3) is full
2. AC(2) is full
3. Both AC's full

According to above conditions,

AC is full then changing frame destination AC. Packet switching methods use for sending them to another AC's. If AC(3) is full then send frames to AC(2), If AC(2) is full then send frames to AC(1) and If Both are full then send frames to Lower AC. proposed flowchart depicted in figure 2

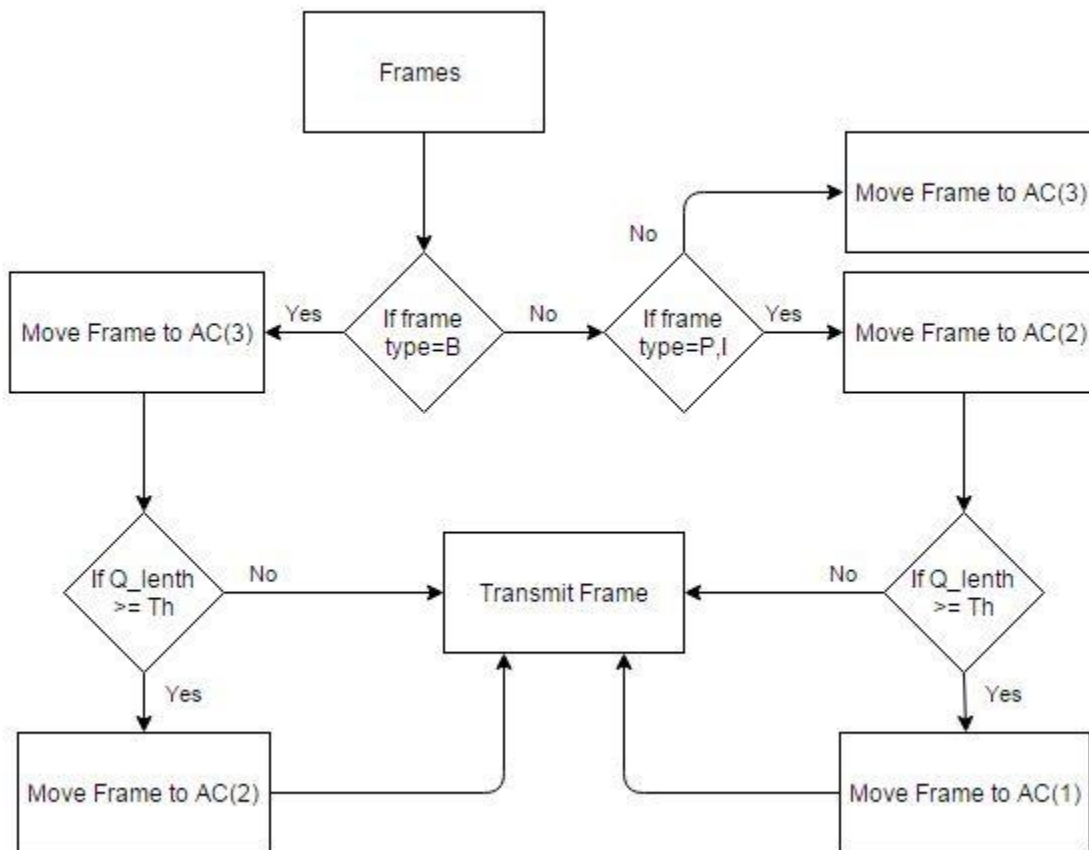


Figure 2 proposed flowchart

Proposed Algorithm :

I,B,P are types of frames.

Olen = Occupied queue lenth

A = function of current queue occupancy

TXOPLIMIT (transmit opportunity parameter in milisecond)

AC = Access categorys(i.e AC0,AC1,AC2,AC3)

Node Receive Frame :

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if Frame type is B then
Map video packet to AC3
Else if Frame type is P,I then
Map video packet to AC2
end if

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Algorithm for AC3 :

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for every time interval
if (Qlen > Upper threshold) then increment TXOPLIMIT by factor  $\alpha$  mapped B to AC2
transmit frames
if (Qlen < Lower threshold) then
restore TXOPLIMIT
transmit frames
end if
else
restore TXOPLIMIT
transmit frames
end if

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Algorithm for AC2 :

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for every time interval
if (Qlen > Upper threshold) then increment TXOPLIMIT by factor  $\alpha$  mapped I,P to AC1
transmit frames
if (Qlen < Lower threshold) then
restore TXOPLIMIT
transmit frames
end if
else
restore TXOPLIMIT
transmit frames
end if

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3. TOOLS AND TECHNOLOGY

NS2:

NS2 stands for Network Simulator version 2. NS2 is an widely available open-source simulation tool that runs on Linux machine. It is a attentive event simulator targeted at networking research and gives substantial support for simulation of routing, multicast protocols and IP protocols and others protocol like UDP, TCP, RTP and SRM over wired and wireless networks. It has many advantages that make it strong and useful tool, such as support for various protocols and the facility of graphically detailing network traffic. Additionally, NS2 supports several various algorithms in routing and queuing. LAN routing and broadcasts are example of routing algorithms. Queuing algorithms like fair queuing, deficit round-robin and FIFO. Basically NS2 started as a alternative of the REAL network simulator. REAL is a network simulator originally developed for studying the dynamic behaviour of flow and congestion control schemes in packet-switched data networks.

Evalvid :

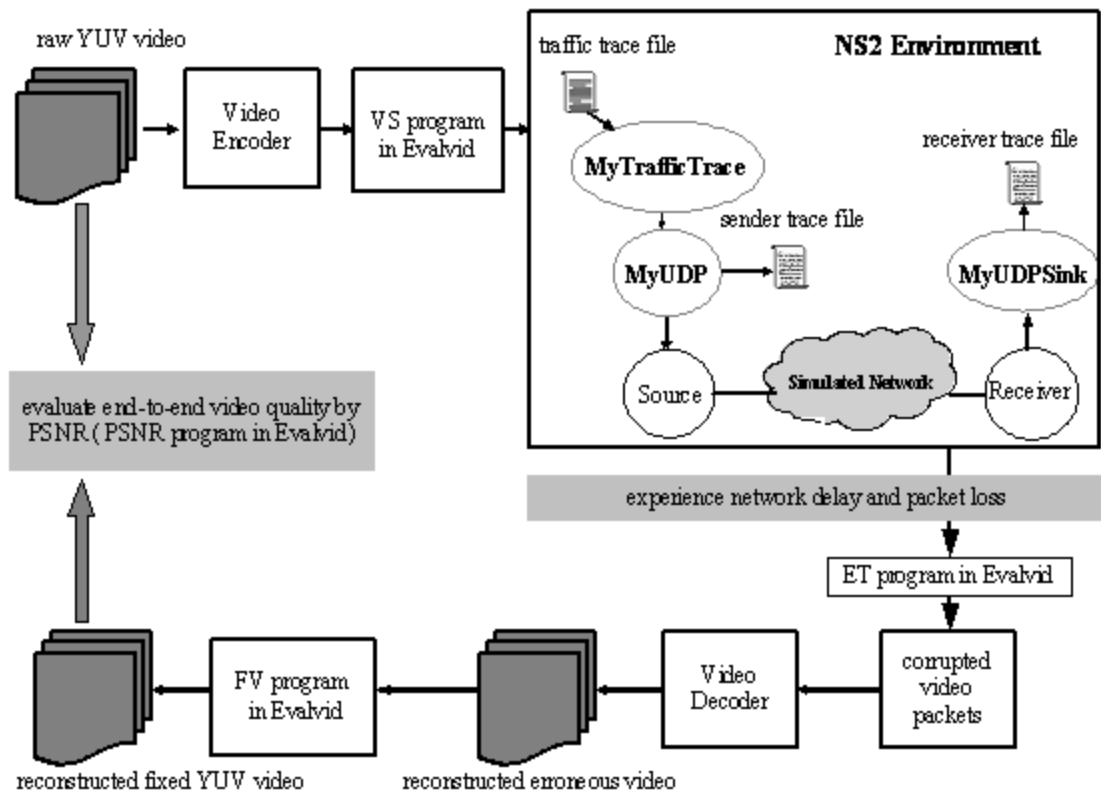


Figure 3 Working of Evalvid[10]

EvalVid is software contains set of tools its working is described in figure 3. It is also a framework for assessment of the quality of video sending and receiving over a real or simulated communication network. It helps the user as well as for researchers. Researchers evaluate their network design and users have video quality. It is used to measure QoS parameters of the network such as loss rates, end-to-end delays, and jitter. Standard video quality metrics like PSNR and a subjective video quality evaluation metric of the received video are provided. Recently H.264, MPEG-4 and H.263 are supported by Evalvid.

Working of Evalvid

The required data are (the sender side):

- raw uncompressed video
- encoded video
- type of every packet and time-stamp sent

And the receiver side:

- type of every packet and time-stamp received
- reassembled encoded video (possibly faulty)
- raw uncompressed video to be displayed

The calculation of these data is done on the sender side, so the information from the receiver side has to be transported back to the sender.

There are 3 stages of processing of data:

Stage 1:

It requires the timestamps from each sides. It also needs the packet types. The results of this stage are the frame-type based loss rates and the inter-packet times. again video file having error from the receiver side is reconstructed using the original encoded video file and the packet loss information. This video can now be decoded compliant the raw video frames which would be displayed to the user. There is a common problem of video quality evaluation arrives. Video quality metrics always wants the comparison of the displayed frame with the equivalent original frame.

Stage 2:

It provides a solution to this problem. Recovery is inserting last displayed frame for every lost frame. The loss information is capturing then frame synchronization is done. This makes further quality measurement feasible.

Stage 3:

To getting the video quality, Both file (fixed and original raw file) are used. For the tools within EvalVid only trace files, the original video file and the decoder files are required. Since the only interaction of EvalVid and the network is described by the two trace files (sender and receiver), the network box can be easily replaced. So, EvalVid is very flexible,feasible and easy to use. Similarly, the video codec can also be easily replaced.

YUV :

YUV is a color having three components Y,U and V. It is used as part of a color image pipeline. It deals with encoding of the image generated as colored and/or video taking person awareness into explanation, allowing reduced bandwidth for chrominance components, thereby naturally being enable transmission errors to be more powerfully masked by the human awareness than using a "direct" RGB-representation. The YUV model having two types of components like Y' and UV. Here, Y' is said to luma and UV is said to b chrominance. For brightness the luma (Y') is used and for color the chrominance used. Here, luminance is represented by Y. Digital multimedia is often encoded in a YUV format. Due to some history problems, analog television uses YUV. The new generation television signals are color for analog television. The old generation is for the black and white television. New generation television is design for challenge to old one. The new generation television signal takes the chroma components importance onto the luma signal components. Chroma will be ignored by black-and-white televisions and display the signal as a grayscale image. Signals are extracted in color televisions like chroma and converted back to RGB. Digital video usually uses Y'CbCr. It is the form of YUV called. Basically, Y'CbCr works by scaling the YUV components to the following ranges:

Table 1 YUV components and ranges

Component	Range
Y'	16-235
Cb/Cr	16-240, with 128 representing zero

Above described ranges are assumed with 8 bits of correctness for the Y'CbCr components. Raw YUV format actually just denote that the file stores video data in raw, uncompressed YUV format. Due to same size of each file, it is constant bit rate which is constant. It can be either in the YUV QCIF (176 x 144) or in the YUV CIF (352 x 288) formats.

4. IMPLEMENTATION RESULT

Packet Delivery Ratio:

Figure 4 depicted packet delivery ratio. graphs describes the ratio of the number of delivered data packet to the destination. This illustrates the level of delivered data to the destination.

$$\sum \text{Number of packet receive} / \sum \text{Number of packet send} = 269/300 = 0.89.$$

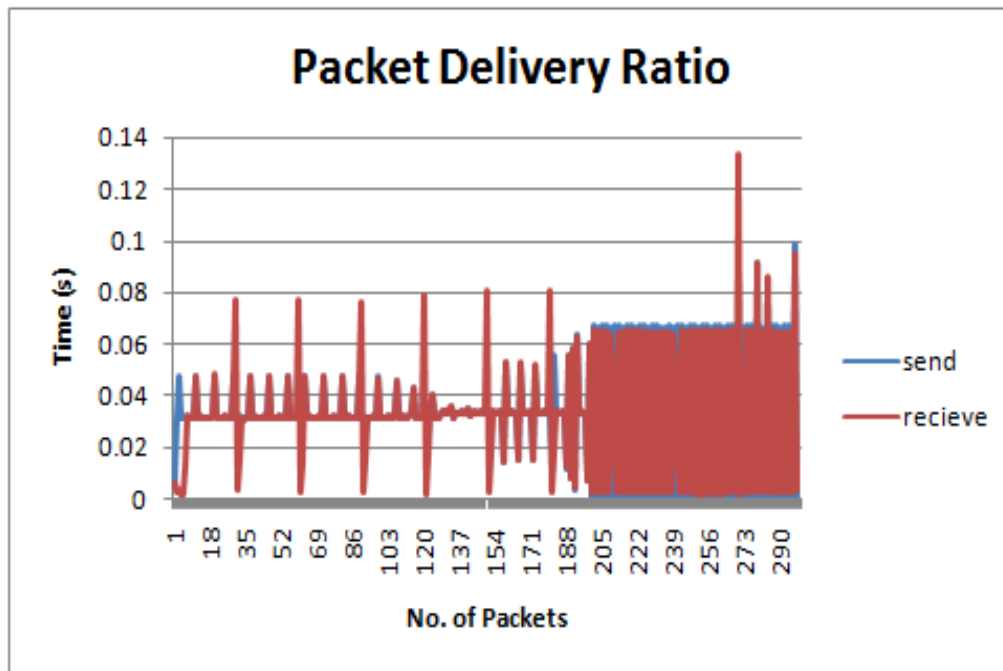


Figure 4 Graph for packet transmission

PSNR(peak signal to noise ratio) :

PSNR result depicted in figure 5 that shows the proposed methodology improves the psnr value as compare to existing aodv protocol used. The value is higher than 30db says good quality improvements.

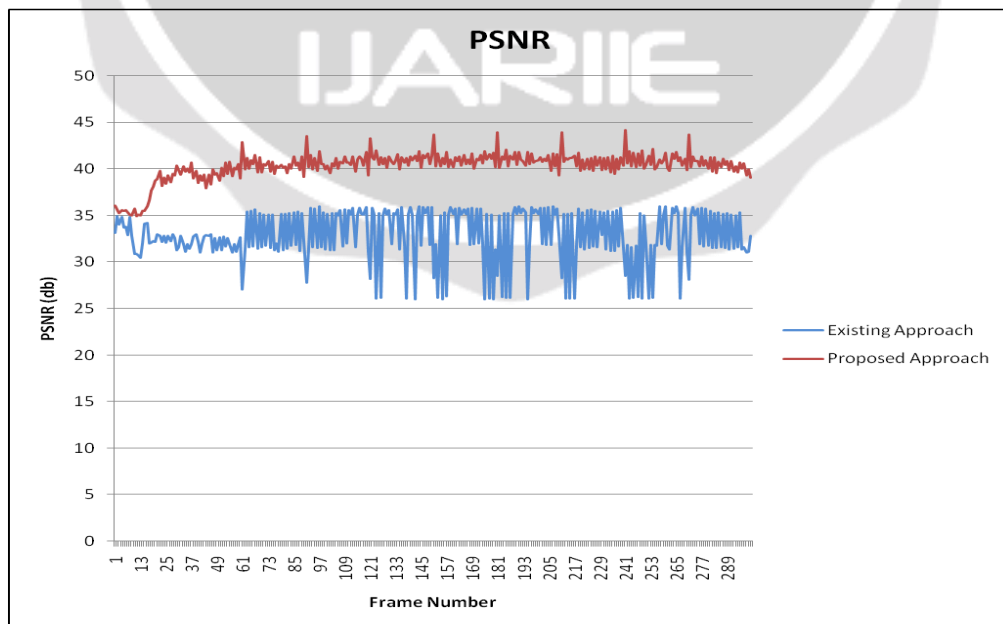


Figure 5 Comparison graph of PSNR

VQM (video quality measure) :

VQM result depicted in figure 6 that shows the proposed methodology improve the video quality value as compare to existing protocol used. The value is nearest to 1 has good quality improvement in video transmission.

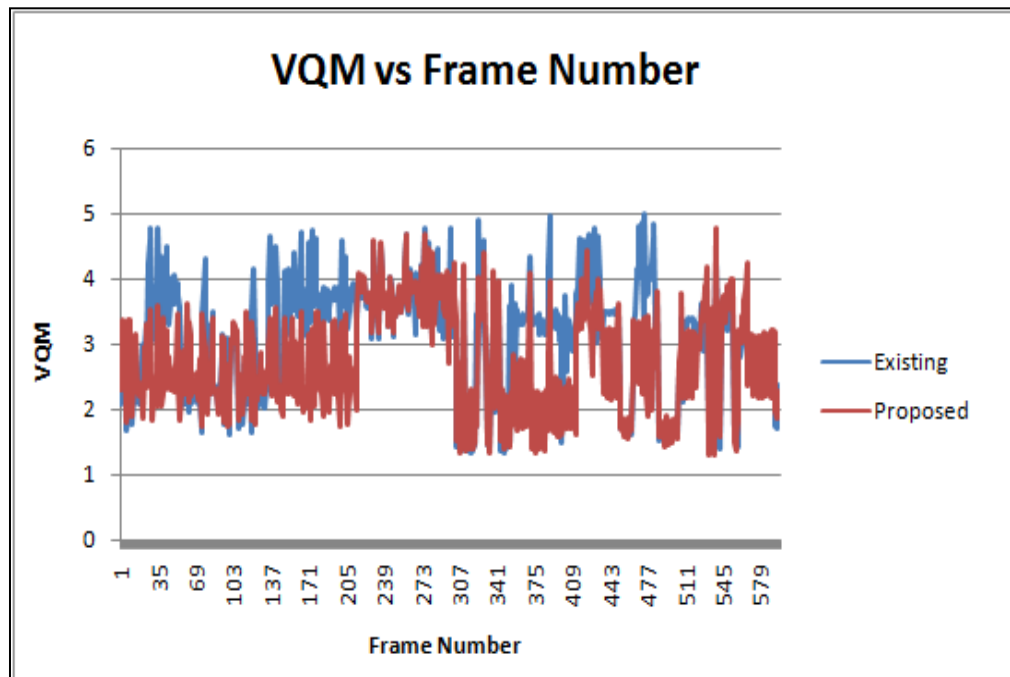


Figure 6 Comparison graph of VQM

5. CONCLUSIONS

several advantages and disadvantages of multimedia transmission for QoS were discussed. We have summarized the operation, strengths and drawbacks of existing multimedia transmission approaches in order to expose the current trends of progress in the field and to identify the topics for further research. We making new method with changing the static EDCA approach. Changing in transmission of most important I-frame first to getting better video quality. With the use of Qos parameters like PDR, PSNR, VQM and packet switching concept we get high video quality. Hence, we can conclude that from the experimental result, Using this approach we get better multimedia transmission over wireless networks.

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