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A CROSS-LAYER APPROACH FOR TRANSMISSION OF MPEG-4 VIDEO OVER WIRELESS MESH NETWORKS

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ABSTRACT

Video streaming over wireless LANs in real time is very challenging due to the time-varying wireless channel characteristics. While transmitting MPEG-4 video over Wireless Mesh Networks many parameters such as delay, latency needs to be considered. For such time critical application a new Cross layer approach is proposed. A Cross-layer approach provides freedom to exchange information among different layers to enhance the video quality. Parameters can be exchanged between Application, Network and Data link layer to improve quality of service. At the application layer the information about the video frames can be shared with the network layer so that appropriate routing metrics can be chosen. Commonly routing protocol uses hop count as routing metrics to find out the best route. The modified protocol uses Expected Transmission Count (ETX) metric along with hop count to select best QoS route. The approach improves the performance metrics such as throughput, packet delivery ratio, end to end delay and reduces total video frame loss.

KEYWORDS: Cross layer approach ,Expected Transmission count,IEEE 802.11e, MPEG-4.

INTRODUCTION

Wireless technology provides pervasive services such as multimedia traffic and data traffic.Delivery of multimedia traffic pose major challenge as the QoS of the network must be maintained.Hence wireless network must be designed efficiently.Cross-Layer approach provides full freedom to exchange the parameter information among different layers. Fluctuating channel characteristics ,interference,congestion in network degrades the video quality.Joint optimization of network parameters at different OSI layers can be done which can assure good video quality.One of the major issue of the wireless network is the limited availability of bandwidth.In order to overcome this problem many compression techniques are designed so as to meet bandwidth requirements.Commonly used compression techniques are MPEG-2,MPEG-4,H.261,H.264 etc.Major picture types used in MPEG-4 are I,P,B frames.The information about the frame type is available at the application layer.Thus application layer passes the information about the frames and the priority of the frames to the lower layers to select appropriate network parameter.When multiple paths and multiple metrics are simultaneously used for forwarding the video packets,the assignment of the traffic for video stream must be considered.

In this paper we discuss the modified AOMDV protocol which uses cross layer approach to route the video frames depending on the priority and ensure better service quality.

RELATED WORK

Performance of the H.264 video is improved by cross layer design that optimizes the H.264 packet size[1].Optimized frame length are obtained using fragmentation mechanism.Integrated cross-layer optimization algorithm was propsed in [2] which considered modulation rate,routing,packet scheduling for efficient video transmission over wireless networks.Wei and Zakhor proposed interference aware multipath routing protocol that estimates the packet drop probability depending upon the interference between the links[3].

Adaptive Dynamic mapping algorithm was proposed in [4] that considered video frame priority.IEEE 802.11e provides quality of service by defining different access category.In this approach the MPEG-4 video frames are mapped to access categories depending upon the frame priority.

PROPOSED SYSTEM

 In the proposed method,the application layer passes information about video frames to network layer.Depending on the video frame received the network layer makes decision to use ETX metric or hop count.If the received frame is video frame then the protocol switches to ETX metric.I and P frames are transmitted through link having highest link quality.B frame is transmitted through the link having second less link quality.I frame is the highest priority frame and hence it is transmitted through the link with highest link quality.

Algorithm:
1)   I,P,B frames are defined at application layer.
2)   If the received frame is video frame the protocol switches to ETX Metric.
3)   If the video frame is I or P frame the path with highest link quality is assigned to it.
4)   If the video frame is B frame the second highest link quality path is assigned.
5)   For the rest of the traffic minimum hop count metric is used.

VIDEO PROCESSING USING EVALVID TOOL

Evalvid is a framework that is used for video transmission and evaluation of video quality. Video processing is carried out in Cygwin environment.The standard qcif (176 * 144) Foreman video is taken as sample which is in raw YUV format.FFMPEG is used to compress the video in raw format[5].Video processing is carried out in following steps:

Step 1: Encode the raw yuv video with ffmpeg.
In this step raw QCIF   YUV video is converted to m4v by defining following parameters:
   1.   Group Of Picture (g) =9
   2.   Rate (r) =30 frames/second
   3.   Number of b frames between I/P and P/I frame (bf) = 2.
   4.   Quantization scale (qscale) =1

The value for the quantization scale can vary between 1 to 31.Quantization scale having value 1 has the best video quality as compared to the quantization scale having value 31.

Command:
./ffmpeg.exe –s qcif –vcodec mpeg4 –r 30 –g 9 –bf 2 –qscale 1 –i foreman_qcif.yuv foreman_qcif.m4v

Fig 1 Encode Raw YUV video into m4v

Fig 2 Encoded m4V video

Step 2: Use MP4Box to Convert m4v to mp4
MP4Box generates the hint tracks. The server uses these hint tracks to transmit packets over the network. MTU is the Maximum transmission unit. It defines the maximum packet size that is needed to transmit the video. Fps defines number of frames transmitted per second. In this case 30 frames are transmitted per second.

Command:
./MP4Box.exe –hint –mtu 1024 –fps 30 –add foreman_qcif.m4v foreman_qcif.mp4

Fig 3 Convert m4v to mp4

Fig 4 mp4 video

Step 3: The mp4trace sends a mp4-file per RTP/UDP/IP to a specified destination host.
Command:
./mp4trace.exe   –f   –s   192.168.0.2   12346 foreman_qcif.mp4 > foreman_qcif.st

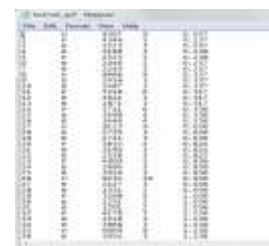**Fig 5 Convert mp4 file to file format**

Fig 6 Foreman_qcif.st

Fig 6 shows the Foreman_st file that contains the information about the I,P and B frames.The first columns indicates the frame number.The second columns indicates frame type,the third indicates frame size ,the fourth indicates the total number of

packets needed to send out the frame.The last column indicates the sending time.

This data file is used in tcl script in NS2 by the source to transmit packets to the destination.The three interfaces:MyTrafficTrace,MyUDP and MyUDPSink are designed to evaluate the video quality. MyTrafficTrace extract the information of video such as type of frame and frame size.MyUDP is an extension of UDP agent. MyTrafficTrace extract the information of video such as type of frame and frame size.MyUDP is an extension of UDP agent.

SIMULATION CONFIGURATION

Performance of video streaming is evaluated in grid wireless network.The network topology consists of 16 nodes in 200m x 200m area with 50 m as horizontal and vertical spacing.Table 1 shows the Network traffic flow parameters.

Table 1 : Network Flow Parameters

Flow Parameters	Video traffic	Background traffic
Packet size	1000bytes	512 bytes
Data rate	1Mbps	1Mbps

Fig 7 shows the wireless grid with 16 nodes.The routing protocol is implemented in NS2 in ns2.35[6].

Fig 7 Wireless Mesh Network

Modifications are made to the AOMDV protocol to transmit MPEG-4 video over the wireless network.

RESULTS AND DISCUSSION

Figure 8 shows Packet delivery ratio (PDR).PDR for modified protocol is better than AODV.

$$PDR = \frac{\sum(\text{Number of Packet Receive })}{\sum(\text{Number of Packet Send })}$$
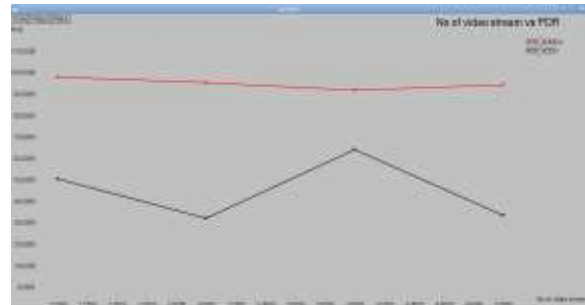

Fig 8 Packet delivery ratio

Figure 9 shows that the Routing overhead for the Modified protocol is less as compared to AODV protocol.
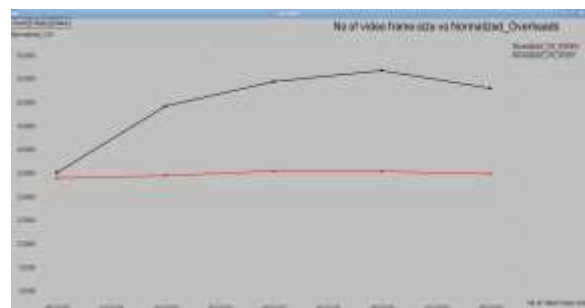

Fig 9 Normalized Overhead

Figure 10 shows that End to End delay of Modified protocol is less as compared to AODV protocol. End-to-End Delay (E2ED) refers to time occupied by a data packet travel from a source to a destination in a network. Here only data that reaches successfully to the destination are considered. The less the value the better is the performance.
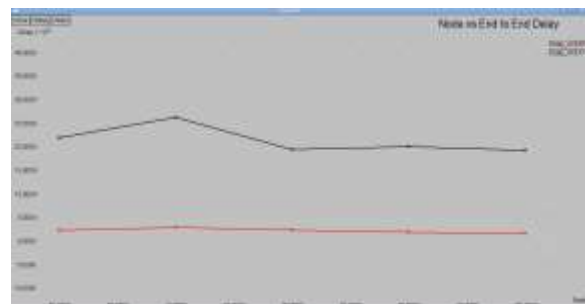

Fig 10 End to End Delay

Fig 11 shows that the new routing protocol has better improvement in throughput as compared with AODV.Throughput can be defined as the ratio of the total bytes in data packets received by destination nodes to time from first packets generated at a source to last packet received by sink nodes.
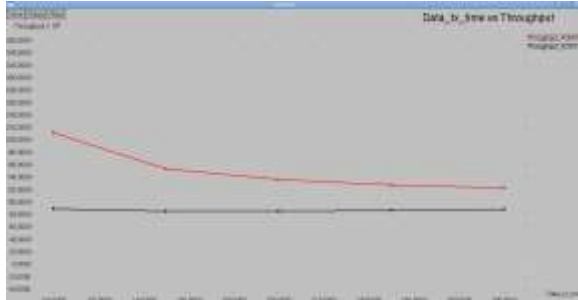
Fig 11 Throughput

CONCLUSION

The proposed protocol uses CrossLayer approach to improve the quality of MPEG-4 video. Result obtained from simulation shows that the video quality is enhanced.The protocol performs better in terms of Packet delivery ratio,Normalized overhead,end to end delay and throughput.

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