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VIDEO TRANSMISSION OVER WIRELESS NETWORKS REVIEW AND RECENT ADVANCES

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Abstract: Video transmission over wireless networks is considered the most interesting application in our daily life nowadays. As mobile data rates continue to increase and more people rely on wireless transmission, the amount of video transmitted over at least one wireless hop will likely continue to increase. This kind of application needs large bandwidth, efficient routing protocols, and content delivery methods to provide smooth video playback to the receivers. Current generation wireless networks are likely to operate on internet technology combined with various access technologies. Achieving effective bandwidth aggregation in wireless environments raises several challenges related to deployment, link heterogeneity, Network congestion, network fluctuation, and energy consumption. In this work, an overview of technical challenges of over wireless networks is presented. A survey of wireless networks in recent video transmission schemes is introduced. Demonstration results of few scenarios are showed.

Keywords: Video coding, video compression, wireless video transmission

1. INTRODUCTION

Video has been an important media for communications and entertainment for many decades. Initially Communication ways have changed from smoke signal to digital signals. These days technology is improving such that people can talk face to face over 4G /Wi-Fi network using computers without bothering distance between them. Though technically all this service uses internet for transmitting voice over network. Now these days we have so many technologies that support communication over internet like chatting, live video chatting, and calling from one computer to other [1]. The evolution of internet has also increased the demand for multimedia content. Multimedia is the media that uses multiple forms of information content and information processing (e.g. text, audio, video, graphics, animation, interactivity) to inform or entertain the user. Multimedia means that represented the computer information through audio, video, image, graphics and animation in addition to traditional media [2]. It is possible to achieve higher aggregate data transmission rate while choosing several spatially distributed paths, thus benefiting from the spatial reuse of a wireless channel. That in its turn allows achieving higher video quality. Multipath routing allows the establishment of multiple paths between a single source and single destination node. It is typically increase the reliability of data transmission or to provide load balancing. Streaming media may be either real time or on-demand. On demand streams are stored on the server and based on the user requirement content is transmitted. Then, user may play video or may download the video for viewing purpose. Real time stream are only available on a some particular time. For example, when the event is occurring and user can record the video .Video Communication may be point to point communication, multicast or broadcast. Video may be pre-encoded or may be encoded in real time [2]

Upon the client's request, a streaming server retrieves compressed video/audio data from storage devices and then the application-layer QoS control module adapts the video/audio bit-streams according to the network status and QoS requirements [3]. After the adaptation, the transport protocols packetize the compressed bit-streams and send the video/audio packets to the Internet[4]. Packets may be dropped or experience excessive delay inside the Internet due to congestion. For packets that are successfully delivered to the receiver, they first pass through the transport layers and then are processed by the application layer before being decoded at the video/audio decoder[5]. To achieve synchronization between video and audio presentations, media synchronization mechanisms are required.

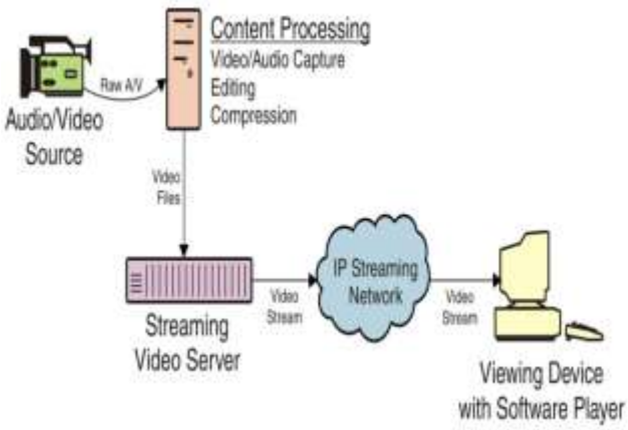

Figure .1 Internet Video Streaming Architecture

2. VIDEO STREAMING

Video streaming over computer networks is considered to become the most interesting application in the near future. There are three types of delivery methods of streaming media; Streaming Stored Audio and Video, Streaming Live Audio and Video and Real-Time Interactive Audio and Video. Figure 2 show the overall Architecture for Video Streaming [6].

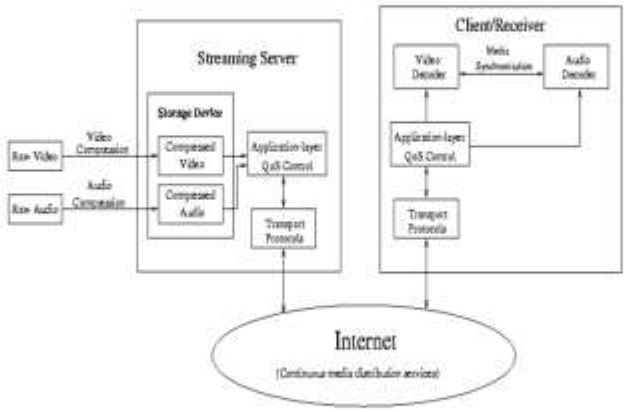

Figure 2 Architecture for Video Streaming [5]

This kind of application needs large bandwidth, efficient routing protocols, and content delivery methods to provide smooth video playback to the receivers. Video streaming systems are classified into two categories including:

2.1 Live video Streaming

In live video streaming, synchronized streams are played back in all nodes, and all users watch the same video frames simultaneously.

2.2 Video on Demand

(VoD) streaming, users watch different video frames of the same video stream at a given instant of time. In other words, the playbacks of the same video streams on different clients are not synchronized for a VoD streaming. Real-time multimedia data applications, such as video streaming and video telephony, are regarded as "killer applications" in the emerging wireless networks. Video applications usually involve a large volume of data transmitted in a time sensitive fashion [7]. However, the underlying wireless networks only provide time-varying and limited bandwidth, high data error rate, packet delay and jitter. Extensive research has been done on either video data coding algorithms or wireless network protocols. But the traditional layered network model limits the video transmission over wireless networks because it tries to separate information and functions between different layers[8]. To enable more efficient real-time data transmission over dynamic wireless environments, the applications and underlying wireless networks should cooperate in order to share information and optimize the transmission process dynamically. In this parts reviews the state-of-the-art research efforts on video coding, error control, and rate control algorithms. New cross-layer algorithms are presented which coordinate the algorithms at different layers in order to get better performance than using them separately. The cross-layer rate control algorithm matches the application's future bandwidth requirement to the available bandwidth in the network so that an optimum data transmission rate can be selected. In cross-layer architecture, layers exchange information and jointly optimize in order to improve the overall performance[9]. Also the cross-layer error control algorithm, lower layers are responsible for error detection and fast retransmission, while application layer conducts an adaptive error correction algorithm with the help of lower layers [10].

Multimedia services and applications became the driving force in the development and widespread deployment of wireless broadband access technologies and high speed local area networks. Mobile phone service providers are now offering a wide range of multimedia applications over high speed wireless data networks. People can watch live TV, stream on-demand video clips and place video telephony calls using multimedia capable mobile devices. The variety and quality of these applications are increasing every day. Mobile devices will soon support capturing and displaying high definition video. Similar evolution is also occurring in the local area domain. The video receiver or storage devices were conventionally connected to display devices using cables. By using wireless local area networking (WLAN) technologies, convenient and cable-free connectivity can be achieved. Media over wireless home networks prevents the cable mess and provides mobility to portable TVs.

However, there still exits challenges for improving the quality-of-service (QoS) of multimedia applications. Conventional service architectures, network structures and protocols lack to provide a robust distribution medium since most of them are not designed considering the high data rate and real-time transmission requirements of digital video[11].

3. LITERATURE REVIEW AND RELATED WORK

Many researchers are working on improving the video transmission over wireless network via different approaches Table.2 shows some of the recent state of the art or contributions in this area, it is classified the video transmission schemes into three major schemes:

(A) Cross Layer Design Schemes(CLDS)
(B) Multiple Descriptions Coding Schemes(MDCS)
(C) Multipath Routing Schemes (MPRS)
(D) Resource Allocation Schemes(RAS)

Table.2 State of the art of the recent video transmission schemes

Author(s)	Proposed Method	Gained Results (Contributions)	Limitation(s)
[15]- Vinod B. and et al. [2013]	(1)-Without considering channel status Condition (2)-The video signal is encoded with the H.264 coding technique at the frame rate of 24 frames per second, with bit rate of 100kbps. (3)-Develop methods to take care of resource allocation in cooperative wireless sensor networks (CWSNs).	From this simulation result, we observed that: rather than encoding the frame itself, the difference between current frame and the previous frame is encoded so that the amount of information transmitted will be drastically reduced.	(1)-The frames can be properly analyzed to assign the security codes. (2)-Since energy is the crucial parameter in the cooperative wireless sensor networks, the resource allocated may be controlled using cross layer design based on the priority

[16] P. A. Chaparro, and et al.[2010]	(1)- Presented DACME-SV, a novel QoS framework to support scalable video transmission over MANETs. (2)- Benefits of using this novel solution that combines the flexibility of the H.264/SVC codec with distributed admission control algorithms. (3)-The strategy proposed allows to dynamically adjust the video quality according to end-to-end path conditions, thus optimizing available resource usage.	(1)- Experimental showed that DACME-SV is able to improve global performance by decreasing the frequency of interruptions on video communications, while simultaneously improving fairness among users by favoring similar conditions for QoS flows. (2)-Channel utilization was also improved with this strategy.	As future work they plan to introduce further improvements to DACME-SV by also including support for end to-end delay bounds.
[17] Detti and et al. [2010]	(1)-Evaluated and demonstrated a technique for streaming H.264 SVC video over a DDS middleware. (2)-The structure of the DDS data unit designed by them was able to carry H.264 SVC video-units. (3)-Also they designed a receiver-driven rate-control mechanism based on the DDS data unit, which exploited specific DDS functionality.	Their implementation showed the effectiveness of their mechanism in IEEE 802.11 wireless scenario, comparing their proposal with other solutions.	It is a demonstration work with out explaining the theory behind.
[18]Kalvein Rantelobo, et al. [2012]	(1)- Create Combined Scalable Video Coding (CSVC) method that match the QoS of video streaming service on wireless channel (2)- Use Joint Scalable Video Model (JSVM) amendment standard. (3)- The proposed scheme has implemented on Network Simulator II (NS2) for wireless broadband network application. (4)- This new scheme is an evaluation platform for the implementation CSVC on a more realistic simulation over wireless broadband networks based on open-source program. (5)- The results show that implementation of CSVC on mode of the medium grain scalable (MGS) outperforms coarse grain scalable (CGS) mode.	(1)-T his research proves that CGS and MGS mode on video transmission on wireless broadband network (WLAN IEEE 802.11e) is implementable on NS2 we ll. (2)-T he use of mode MGS gave result t hat is more satisfactory compared to CGS mode. (3)-Investigated the impacts of the use of MG S and CGS modes on performance of this system (4)-T he applications of MG S mode on CSV C increases the performance compared to CGS mode.	Video transmission based on the CSVC over broadband wireless network (WLAN IEEE 802.11e), simulated by NS2 with ideal assumption conditions.
[19] Gopikrishnan. R[2014]	(1)-proposed a novel MAC-level multicast protocol named REMP (2)-In REMP, AP selectively retransmits erroneous multicast frames and dynamically adjusts MCS under varying channel conditions based on the advanced feedback mechanism from multicast receivers. (3)- In addition, he proposed S-REMP, an extended version of REMP , for efficient delivery of scalable video over IEEE 802.11n WLANs.	(1)- Via extensive simulation results, we proved the effectiveness of the proposed protocols enhances the reliability and efficiency of multicast transmissions in IEEE 802.11n WLANs. (3)- In S-REMP, different layers of scalable video can be transmitted with different MCSs to provide the minimal video quality to all users while providing a higher video quality to users exhibiting better channel conditions.	In this work S-REMP to guarantee minimal video quality to all users in future work to guarantee a maximal video quality to all users.

4. Result Analysis for Simulation Scenario

In this simulation scenario, there are 9 QoS active stations transmitting data to one access point. There are 3 groups of stations with three stations each. The first group transmits video flow, while the second transmits voice flow and the third transmits best effort data flow. The same simulation parameters in Table 3 are used in this scenario.

In this scenario, the aim is to study the effect of varying the propagation distance on the performance of IEEE802.11e WLAN. The propagation distance was changed by varying the topology from 100 to 1000 square meters. All the QoS active stations move randomly within the coverage area of the access point. All the results are average over five simulations to overcome the errors occur when the stations move on the borders of the coverage area.

The second scenario shows the effect of varying the propagation distance on the average end-to-end delay and the packet loss ratio. These two performance metrics are affected the most in this simulation. Figure 7 illustrates the relationship between the average end-to-end delay and the change of topology.

Table 3 Enhanced EDCA Simulation Parameters

Simulation Parameter	**Video**	**Voice**	**Best effort**
Transport Protocol	UDP	UDP	UDP
CW_{min}	3	7	15
CW_{max}	7	15	1023
AIFSN	1	2	3
Packet Size (bytes)	1028	160	1500
Packet Interval (ms)	10	20	12.5
Data rate (kbps)	822.40	64	960

In Figure 3, it is clearly shown that the average end-to-end delay increases with the increase of the propagation distance from source to destination. However, the delay difference between the different flows is clear. This is due to the channel prioritization performed by EDCA and HCCA enhanced functions. The end-to-end delay value of the video flow is still acceptable even when the topology is 1000 square meters, while it is not for the voice and best effort data flows. More details and explanations are provided in the discussion sub-section.

Figure 4 shows the packet loss ratio change while varying the topology area. The packet drop has different starting value of topology area for different priorities.

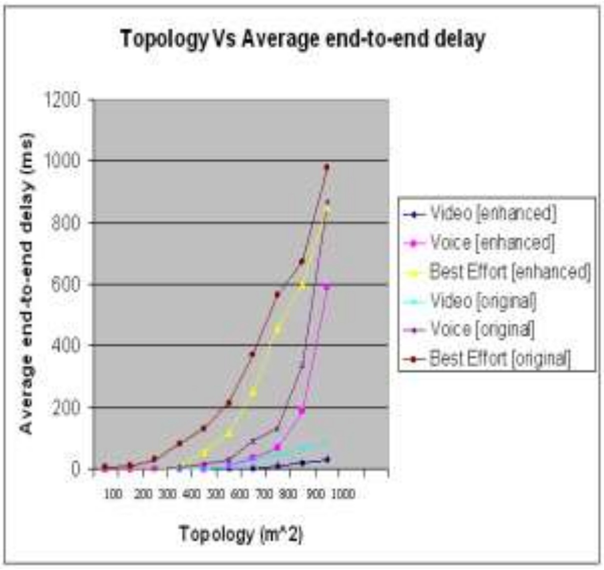

Figure 3: The effect of topology change on average end-to-end delay of three data flows (voice, video and best effort data) using original & enhanced EDCA values.

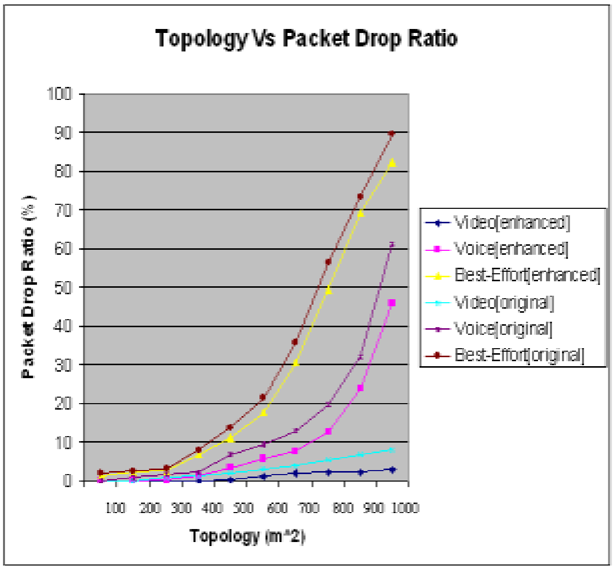

Figure 4: The effect of topology change on Packet Drop Ratio of three data flows (voice, video and best effort data) using original & enhanced EDCA values.

For example, as shown in Figure 4; regarding the enhanced values, the packet drop for the video flow starts when the topology is 500 square meters, while it starts at 100 and 300 square meters for the best effort data and voice flows respectively. On the other hand, when the topology area is 1000 square meters, the differentiation between the three flows is much clearer concerning the packet drop ratio.

5. CONCLUSION

Video transmission over wireless networks and the internet is a challenging task due to the stringent QoS required by video applications and also affected by many channel impairments. By using a fast mode decision algorithm for H.264 intra prediction and an adaptive transmission control methods of video can gain good QoS and achieves 30% to 60% computation reduction on aspects of video coding, so that the stability and good qualities of video transmission can be ensured. Based on the above investigation the work can be continued in the following areas which includes efficient video coding, reliable wireless transmission, QoS, transmission rate, energy efficiency of handheld devices to improve the overall wireless video transmission system.

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