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A Review on an Access Point-Based FEC Mechanism for Video Transmission over Wireless LANs

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ABSTRACT: Video transmission over the wireless network faces many challenges. The most critical challenge is related to packet loss. To overcome the problem of packet loss, Forward Error Correction is used by adding extra packets known as redundant packet or parity packet. Currently, FEC mechanisms have been adopted together with Automatic Repeat request (ARQ) mechanism to overcome packet losses and avoid network congestion in various wireless network conditions. In the current Adaptive FEC mechanism, the FEC packets are decided by the average queue length and average packet retransmission times. The Adaptive FEC mechanisms have been proposed to suit the network condition by generating FEC packets adaptively in the wireless network. However, the current Adaptive FEC mechanism has some major drawbacks such as the reduction of recovery performance which injects too many excessive FEC packets into the network. This is not flexible enough to adapt with varying wireless network condition. Therefore, the enhancement of Adaptive FEC mechanism (AFEC) known as Enhanced Adaptive FEC (Enface) has been proposed. The aim is to improve recovery performance on the current Adaptive FEC mechanism by injecting FEC packets dynamically based on varying wireless network conditions. Based on the findings, the optimal amount of FEC generated by Enface mechanism can recover high packet loss and produce good video quality An Enhanced Random Early Detection Forward Error Correction (ERED-FEC) mechanism is implemented to improve the quality of video transmissions over Wireless Local Area Networks (WLANs).

KEYWORDS: Forward error correction, Video transmission, Wireless network, Packet loss, Video quality.

I. INTRODUCTION

In a wireless network, as the external environment changes, the channel error rate varies. In order to cope with errors, accurate channel-condition estimation and an effective error control mechanism is needed. Video communication is fundamentally different from data communication, since interactive video applications are delay and loss sensitive. Unlike data packets, late arriving video packets are useless to the video decoder. Furthermore, due to busty and location dependent errors, each user in a multicast system will most likely lose different packets. Therefore, a simple ARQ (Automatic Repeat request) based scheme is not appropriate for video multicast services over wireless channels since it can cause a large number of retransmissions. A promising solution for error control in multicasting over wireless networks is the use of forward error correction (FEC), where redundant information is sent a-priori by the source station, in order to be used by the receivers to correct errors/losses without contacting the source. The advantage of using FEC for multicasting is that a single parity packet can be used to correct independent single-packet losses among different receivers. The efficiency of FEC-based approaches for error correction in wireless multicasting has been shown via simulations [1]-[4]. Although these simulation results provide some insights on the way FEC should be applied, they do not consider a wireless network with multi-rate capabilities. Broadly speaking, sender-based FEC schemes can be categorized as either Static FEC (SFEC) or Dynamic FEC (DFEC). In SFEC schemes, the number of redundant packets added to the source packets remains constant irrespective of changes in the network condition. The recovery performance of SFEC schemes is therefore somewhat unpredictable because they fail to capture the real-time network conditions and adjust the FEC redundancy rate accordingly. Thus, various DFEC schemes have been proposed in recent years. In most DFEC schemes, the FEC rate is tuned at the sender based on information provided by the receiver.

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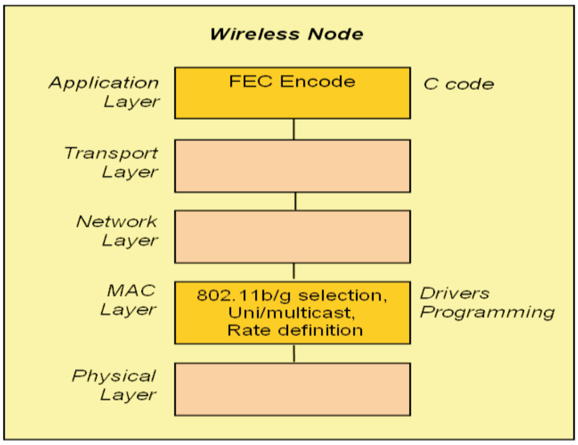

Fig. 1. Node Architecture

II. Related Work

Forward Error Correction (FEC)

The basic principle of FEC entails injecting redundant packets *(h)* into the video stream together with the source transmission packets *(k)* such that packet losses can be recovered at the receiver end without the need for retransmission. In other words, as shown in Fig. 1, the original block is encoded as *(n,k)* packets, where *n* is the summation of source packets *(k)* and redundant packets *(h)* . Thus, provided that no more than packets are lost in transmission, the source transmission packets can be successfully recovered at the receiver.

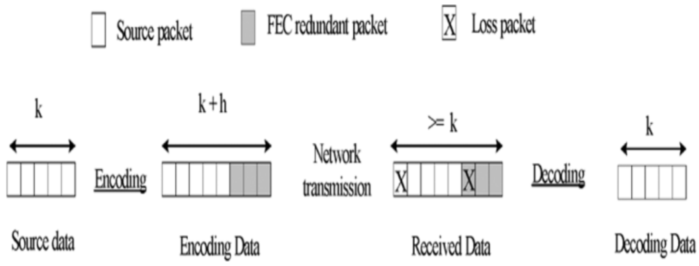

Fig. 2. FEC encoding and decoding.

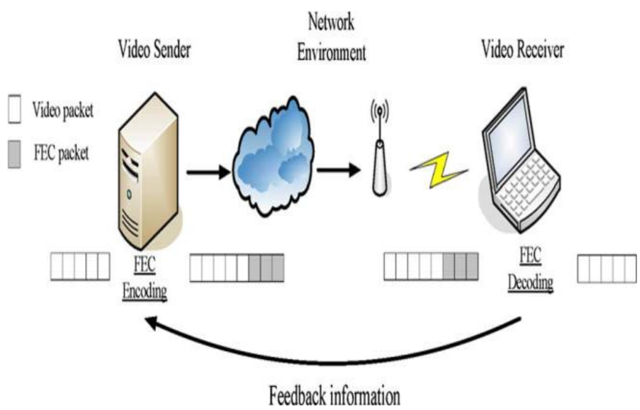

Fig. 3. Sender-based FEC scheme.

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III. SENDER-BASED FEC MECHANISMS

A. *Constant Error Rate FEC (CER-FEC):*

Proposed a sender-based Constant Error Rate FEC (CER-FEC) scheme for enabling the dynamic QoS control of real-time multimedia streams over heterogeneous environments comprising wired and wireless connections. As in the proposed scheme, the packet error rate is periodically observed at the receiver side and any change in the error rate is fed back to the sender. Upon receiving this information, the sender calculates the number of redundant packets required to restore the error rate to its original value. In other words, the FEC redundancy rate is dynamically controlled in such a way as to maintain a constant packet error rate at the receiver end.

B. *Cross-Layer FEC (CL-FEC):*

Proposed an efficient Cross-Layer FEC (CL-FEC) scheme for wireless video multicasting designed to maintain the received video quality for all the users above a certain pre-specified level. In the proposed scheme, each user periodically reports the number of packets received out of the previously transmitted packets. The sender then calculates the number of packets which each user has lost and determines the maximum number of packets which can be decoded by all the users (i.e. the number of decodable packets for the user with the greatest number of packet losses).

C. *Adaptive FEC (AFEC):*

An adaptive FEC (AFEC) protocol for facilitating the end-to-end transport of real-time traffic whose timing constraints rule out the use of retransmission-based congestion control or QoS provisioning schemes. In the proposed approach, the degree of FEC redundancy is tuned in accordance with the current network delay. Specifically, the number of redundant packets is increased as the network delay decreases, but is reduced as the delay increases.

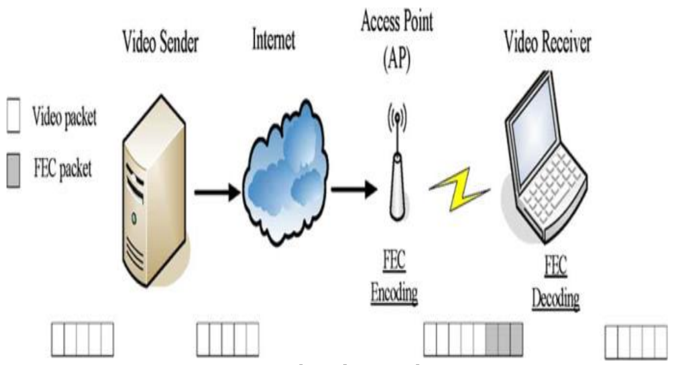

Fig. 4. AP-based FEC scheme.

D. *Basic Concept of ERED-FEC Mechanism:*

Enhanced Random Early Detection Forward Error Correction (ERED-FEC) mechanism is implemented for improving the quality of video transmissions over wireless LANs (WLANs). In the proposed approach, redundant FEC packets are generated dynamically at the AP in accordance with both the condition of the wireless channel and the current network traffic load. The channel condition is evaluated by monitoring the number of packet retransmissions. As the number of retransmissions Increases (i.e., the condition of the wireless channel deteriorates), a greater number of redundant FEC packets are generated. Conversely, as the channel condition improves, the number of FEC packets is reduced. The network traffic load is evaluated by monitoring the queue length at the wireless AP. If the queue is almost empty, i.e., the network is only lightly loaded, the number of redundant FEC packets is increased. By contrast, if the queue is nearly full, i.e., the network is heavily loaded; the number of FEC packets is reduced. By adopting this approach, the ERED-FEC algorithm significantly improves the video quality without overloading the network with an excessive number of redundant packets. An analytical model is proposed for predicting the quality of MPEG-4 video streams delivered over WLANs with FEC protection in terms of the effective packet loss rate and the Decodable Frame Rate (DFR) [22], [23]. It is shown that the model provides the ERED-FEC mechanism with the means to determine the FEC redundancy rate required to guarantee the QoS requirements of video transmissions over lossy wireless networks. Fig. 5 illustrates the basic architecture of the AP-based ERED-FEC mechanism proposed in this study. (Note that an assumption is made that the wired

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segment of the video delivery path is loss free.) As shown, the ERED-FEC mechanism consists of five components, namely (1) a packet type classifier (2)a packet loss monitor (3) a video quality model (4) a network load monitor and (5) a FEC packet generator. During video streaming, the streaming server encapsulates the video data in Real-time Transport Protocol (RTP) packets and delivers them to the receiver through the wireless AP. When packets arrives at the AP, the ERED-FEC controller retrieves the packet header from the UDP, and identifies the packet type by checking the RTP header. Once a complete block of video packets has arrived, the packet loss monitor estimates the packet loss rate by examining the number of packet retransmissions associated with the block. An appropriate FEC redundancy rate is then determined via the video quality model (i.e., the DFR). Finally, the ERED-FEC mechanism checks the queue length at the AP in order to evaluate the current network traffic load, and then uses this information to adjust the FEC redundancy rate (if required).

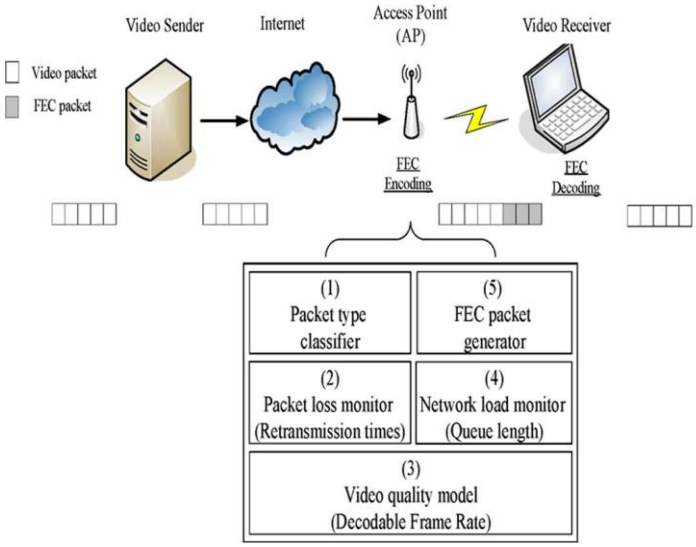

Fig. 5. Architecture of ERED-FEC controller

IV. PROBLEM DEFINITION & OBJECTIVE

Problem Definition

In this research work different papers were studied to find the problem. The following problems were found that are given below:

- There is no guarantee that the FEC rate implemented at the sender end accurately reflects the current network condition.
- The loss of data packets during the transmission of data from source to destination.
- The data redundancy problem is their when same packets are sending again and again on the same network.
- Resource allocation problem during the FEC mechanism for video transmission of data.

Objective

The following objectives are performed in this research work :

- To implement the Enhanced Random Early Detection Forward Error Correction (ERED-FEC) mechanism for improving the quality of video transmissions over wireless LANs.
- To perform Resource scheduling during the transmission.
- To Calculate the Frame rate of the videos over the WLAN.
- To Compare the RED-FEC, ERED-FEC and EERED-FEC Algorithm and analyze the result being obtained.

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V. CONCLUSION AND FUTURE WORK

This paper has presented an AP-based FEC mechanism for improving the quality of video transmissions over WLANs. In contrast to many FEC schemes, in which the FEC rate is determined at the sender end on the basis of information provided by the receiver, in the FEC mechanism proposed in this study, the FEC redundancy rate is determined at the wireless access point (AP).Moreover, the FEC redundancy rate is calculated in accordance with both the wireless channel condition and the network traffic load. As a result, the FEC mechanism significantly improves the video quality without overloading the network with redundant packets. Our future work will include further evaluation of the proposed approach. The different reviews are studied from the different papers.

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BIOGRAPHY

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