ENHANCEMENT OF ADAPTIVE FORWARD ERROR CORRECTION MECHANISM FOR VIDEO TRANSMISSION OVER WIRELESS LOCAL AREA NETWORK

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Abstrak

Penghantaran video melalui rangkaian tanpa wayar menghadapi banyak cabaran. Cabaran paling genting adalah kehilangan paket. Untuk menangani masalah kehilangan paket, *Forward Error Correction (FEC)* telah digunakan, iaitu dengan menambah paket tambahan yang dikenali sebagai paket berlebihan atau paket pariti. Kini, mekanisma FEC telah diterima pakai bersama dengan mekanisma *Automatic Repeat reQuest (ARQ)* untuk mengatasi kehilangan paket dan mengelak kesesakan rangkaian dalam pelbagai keadaan rangkaian tanpa wayar. Jumlah paket FEC perlu dihasilkan secara boleh suai kerana kebiasaannya rangkaian tanpa wayar mempunyai pelbagai keadaan. Dalam mekanisma FEC boleh suai, paket FEC ditentukan berdasarkan purata baris gilir dan purata masa penghantaran semula. Pada dasarnya, mekanisma FEC boleh suai telah dicadangkan untuk disesuaikan dengan keadaan rangkaian melalui penghasilan paket FEC boleh suai dalam rangkaian tanpa wayar. Namun, mekanisma FEC boleh suai pada masa kini mempunyai beberapa kelemahan utama, antaranya, mengurangkan prestasi pemulihan dengan menyuntik terlalu banyak paket FEC ke dalam rangkaian. Ini tidak cukup fleksibel untuk disesuaikan dengan pelbagai keadaan dalam rangkaian tanpa wayar. Oleh itu, penambahbaikan pada mekanisma FEC boleh suai telah dicadangkan iaitu *Enhanced Adaptive FEC (EnAFEC)*. Penambahbaikan tersebut bertujuan untuk meningkatkan prestasi pemulihan pada mekanisma FEC boleh suai pada masa kini dengan menyuntik paket FEC secara dinamik berdasarkan pelbagai keadaan rangkaian tanpa wayar. Mekanisma EnAFEC telah dilaksanakan dalam persekitaran simulasi dengan menggunakan *Network Simulator 2 (NS-2)*. Penilaian prestasi telah dijalankan. EnAFEC telah diuji menggunakan model saluran kesalahan rawak. Hasil daripada eksperimen dan analisis prestasi menunjukkan mekanisma EnAFEC mengungguli mekanisma FEC boleh suai lain berdasarkan kecekapan pemulihan. Dengan ini, jumlah optima FEC yang dihasilkan oleh mekanisma EnAFEC dapat memulihkan kehilangan paket yang banyak dan membolehkan penerima mendapat kualiti video yang lebih bagus.

Kata kunci: *Forward error correction*, Penghantaran video, Rangkaian tanpa wayar, Kehilangan paket, Kualiti video.

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. The number of FEC packets need to be generated effectively because wireless network usually has varying 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 (EnAFEC) 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. The EnAFEC mechanism is implemented in the simulation environment using Network Simulator 2 (NS-2). Performance evaluations are also carried out. The EnAFEC was tested with the random uniform error model. The results from experiments and performance analyses showed that EnAFEC mechanism outperformed the other Adaptive FEC mechanism in terms of recovery efficiency. Based on the findings, the optimal amount of FEC generated by EnAFEC mechanism can recover high packet loss and produce good video quality.

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

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

ACFEC	Adaptive Cross-Layer Forward Error Correction
ACK	Acknowledgement
AEFEC	Adaptive Exponential Forward Error Correction
AFEC	Adaptive FEC
AHAFEC	Hybrid ARQ and Forward Error Correction
ALFEC	Adaptive Linear Forward Error Correction
AP	Access Point
ARQ	Automatic Repeat reQuest
AVC	Advanced Video Coding
BAFEC	Burst Aware Forward Error Correction
BER	Bit Error Rate
CBQ	Class-Based Queuing
CBR	Constant Bit Rate
CTS	Clear-to-Send
EAFEC	Enhanced Adaptive Forward Error Correction
EC	Error Concealment
EWMA	Weighted Moving Average
FE	FEC efficiency
FEC	Forward Error Correction
FIFO	First In First Out
FQ	Fair Queuing
FTP	File Transport Protocol
GE	Gilbert-Eliot
GOB	Group-of-Blocks
GOP	Group of Picture

IBSS	Independent Basic Service Set
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISO/IEC	International Organization for Standardization/ International
ITU-T	International Telecommunications Union-Telecommunication
	Electrotechnical Commission
MAC	*Media Access Control*
MOS	Mean Opinion Score
MPEG	*Moving Picture Experts Group*
NOAH	No Adhoc routing protocol
NS-2	Network Simulator - 2
OTcl	Object-oriented Tool Command Language
PDA	Personal Digital Assistant
PHY	Physical
PQ	Priority Queue
PSNR	Peak Signal Noise Ratio
QCIF	Quarter Common Intermediate Format
QoS	Quality of System
RE	Recovery Efficiency
RED-FEC	Random Early Detection Forward Error Correction
RNG	Random Number Generation
RS	Reed-Solomon
RT	RTS_Threshold
RTCP	RTP Control Protocol
RTP	Real-time Transport Protocol

RTS	Request-to-Send
RTSP	Real Time Streaming Protocol
SFQ	Stochastic Fair Queuing
SIP	Session Initiation Protocol
SVC	Scalable Video Coding
TCP	Transport Control Protocol
UDP	User Datagram Protocol
VINT	Virtual Test Bed Pro

CHAPTER ONE
INTRODUCTION

1.1 Introduction

Due to the rapid growth of the wireless network users and the increased demand for multimedia information on the web, video transmission over the Internet has received wide attention from both users and research communities (Thamizharasan, 2010). Many users prefer to use wireless device such as PDA (Personal Digital Assistant), notebook or mobile phone because of its mobility and convenience.

Multimedia transmission consists of sequences of moving images with sound that are sent in the compressed form over the Internet and displayed by the receiver as they arrived (UTMB Academic Resource, 2007). The examples of video applications are Internet TV, Internet broadcasting and video conferencing. Transmission of video over the wireless network usually has bandwidth constraint, stringent quality of the service requirements, time-varying error-prone and large numbers of users over the wireless network (Hong & Wu, 2008). Video applications usually require special mechanisms that can overcome packet loss without the need of retransmission.

In response to packet loss, Forward Error Correction (FEC) is used with video transmission for error control that is being implemented in application layer. The principle of FEC is to add redundant information so that original messages or packets can be reconstructed in the occurrence of packet loss. With proper amount of redundancy included in transmitted packets, FEC can reduce the impact of packet loss on the video stream. Consequently, the video quality at the receiver end can be improved (Kang & Loguinov, 2007).

The contents of the thesis is for internal user only

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