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Optimal Pricing for Mobile Video Streaming in 3G Wireless Packet Networks

* Ch. Divya ** Dr. P. Govardhan

* M.Tech CSE, VCE (AICTE), Hyderabad, India

** Prof. IT, VCE (AICTE), Hyderabad, India

ABSTRACT

The recent development of mobile phones and 3G networks enable users to enjoy video programs by subscribing to data plans. Due to phone to phone communication technologies and ubiquity of mobile phones, data-plan subscribers are able to redistribute the video content to non-subscribers. Such a redistribution mechanism is a potential competitor for the service provider and is very difficult to trace given the user's high mobility. Real time video communication is very important to the internet applications of video conferencing, video telephony and etc. This paper presents a novel video transmission control algorithm and the KALMAN filter theory, this algorithm can guarantee satisfied performance for video transmission in networks of high packet loss rates. We analyze the optimal price setting for the service provider by investigate the equilibrium between the subscribers and the secondary buyers.

Keywords: Video streaming, KALMAN, Mobiles.

INTRODUCTION

The spread of wireless network accessibility and mobile devices are gaining lots of attentions on ubiquitous multimedia access within the multimedia community in the past decade. Network service providers and researchers are focusing on developing efficient solutions for the ubiquitous access to multimedia data and in particular videos, from everywhere with mobile devices. Mobile-phone users can watch video program over there devices by subscribing to the data plans network service providers. It is important to understand the possible actions of the end users in order to provide better ubiquitous video access services such as quality measure and error control.

The content subscribers and the secondary buyers who are interested in the video data interact with each other and influence each others' decisions and performance. Both groups of users will reach agreement at the equilibrium price that all users have no incentives to deviate. Due to the small coverage and limited power of each mobile device, a subscriber can only sell the content to the secondary buyer with in his/her transmission range, and the distance and channel conditions between users dominate the users decisions. As a very first work on this problem, we focus secondary buyer that the subscribers can sell to. To solve this hybrid user dynamics in the live-video marketing social network, we propose a multiuser game [5] to solve the problem.

The rest of the paper is organized as follows. We introduced novel video transmission, the system model and define the problem and the utility functions for the subscribers and the secondary buyer in section 1, then analyze the optimal strategies for all users and provide the solutions in section 2, Simulation results are in section 3, conclusions in section 4 and future enhancement in section 5.

1. System model

In this section, we introduce the channel, transmission, and rate-distortion model for the video transmission.

The system model diagram is shown in figure 1. There are N subscribers in the network, trying to sell the video stream to the secondary buyer. At the beginning, each subscriber sends his/her own price per unit transmits power as well as the probing signal to the secondary buyer. Since the price information contains only a few bits, we assume that it can be received immediately and perfectly. The probing signal is meant to let the secondary buyer estimate the maximal achievable transmission rate. The secondary buyer has to decide how much power he/she wants to buy from each subscriber. Since scalable video coding is widely used in mobile video streaming [6].

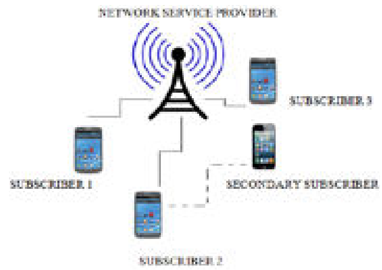

Fig.1 An example of a mobile video stream redistribution network

Suppose the i^{th} subscribers S_i is transmitting the video chunks to the secondary buyer B using power P_i , the channel between them is slow fading channel gain Hi, the distance between them is d_i and the variance of the additive white Gaussian noise at the receiver side is σ^2, then the signal-to-noise ratio (SNR) and the maximal achievable bit rate of the video stream is between S_i and B can be expressed by

$$SN\,R_i = \frac{P_i H_i}{\sqrt{d_i \sigma^2}} \, , and \; R_i = W \log_2 1 + \frac{SNR_i}{\gamma}$$

Where W is the bandwidth of the for transmission, and γ is the capacity gap.

For video streaming service, two common objective quality measures are the video's peak signal-to-noise-ratio and the streaming delay. Here we adopt the polynomial delay model as in [7].

The PSNR of the video stream between S_i and B is PSN R_i $=10\log_{10} 255$, where MS E_i is the mean square error which is the distortion of the reconstructed video. Without loss of generality, in this paper, we use the two- parameter rate-distortion model, which is widely employed in a medium or high bit-rate situation, and other models can be similarly analyzed. Note that the secondary buyer is able to purchase the video from different subscribers in two different ways. Buying different video-stream layers from different subscribers is a better choice. One is asking the subscribers to send the same bit stream, the other is asking the subscribers to send different layers of the video and combine bit stream in decoding process. Since the video bit rate is formulated in (1), the mean square error of the reconstructed video stream can be expressed by

$$MSE= \alpha e^{-\beta \frac{W}{N+1}} P_{i\in N} \log_2 1 + \frac{SNR_i}{\gamma} \quad (2)$$

Where α and β are two positive parameters determined by the characteristics of the video content.

2. Analysis of Optimal Strategies

In this section, we model the behavior of the subscribers and the secondary buyer as a Kaman theory, and then analyze the equilibrium, which leads to the optimal strategies for all users.

2.1 kalman filter theory

The kalman filter, also known as linear quadratic estimation (LQE), is an algorithm that uses a series of measurements observed over time, containing noise and other inaccuracies, and produces estimates of unknown variables that tend to e more precise than those based on a single measurement alone. More formally, the kalman filter operates recursively on streams of noisy input data to produce a statistically optimal estimate of the underlying system state.

The algorithm works in a two-step process. In the prediction step, the kalman filter produces estimates of the current state variables, along with their uncertainties. Once the outcome of the next measurement is observed, these estimates are updated using a weighted average, with more weight being given to estimates with higher certainty.

Extensions and generalizations to the method have also been developed, such as the extended kalman filter and the unscented kalman filter which work on non-linear systems. The underlying model is a Bayesian model similar to a hidden Markov model but where the state space of the latent variables is continuous and where all latent and observed variables have Gaussian distributions.

Actions of subscribers:

Each subscriber S_i can be viewed as a seller and aims to not only earn the payment that covers his/her transmission cost but also gain

The utility of S_i can be define as = $max_j(p_i\text{-}c_i)P_i$,π_S

Where P_i is the power that subscriber i used for transmission. The choice of the optimal price p_i is affected not only by each Subscriber's own channel conditions to each secondary buyer but also by the other subscriber's prices. This is because the seller-level is noncooperation and relay nodes are compete to get selected by source node s. if certain subscriber s1 ask such a high price that make it less beneficial then the other subscriber to the secondary buyer, then secondary buyer will buy less from subscriber s_j and even discard it.

2.2. Equilibrium Analysis

The optimal strategies for both the secondary buyer and subscribers exist by solving the optimal decision for each stage in the back word manner.

2.2.1. The secondary buyer best strategy

We analyze the game in the backward manner by investigating the optimal strategy for the secondary buyer first. The goal of non-subscriber B is to determine the optimal power P_i that B should buy from each subscriber L to minimize his/her own utility.

Let R_B be the video rate that the secondary buyer get subscribers, then according to the rate-distortion model the transmission rate given in (1), the first term in (3) can be formulated as a function of the transmission rate as

$$g_Q \text{ (PSN } R_B \text{ - PSN } R_{max} \text{) = } g' \ R_{max} \quad (3)$$

Combining (1) and (3) with the above equation, we can formulate the utility function of B as a function of $\{P_i \ \forall i \ \in L\}$.

The higher price p_i, the less the power that the secondary buyer is going to purchase. Also, the secondary buyer tends to purchase more power from the subscribers that the signal attenuations in between or less.

2.2.2 Subscribers best strategies

Given the optimal strategy $P*$ of the secondary buyer derived above, each subscriber $S_i \in$ L $\forall$ L_c seek to maximize their utility by setting the optimal pricep_i, which means p*i = c_i . Note that the subscriber is willing to redistribute the video stream only if he/she can profit from the redistribution action.

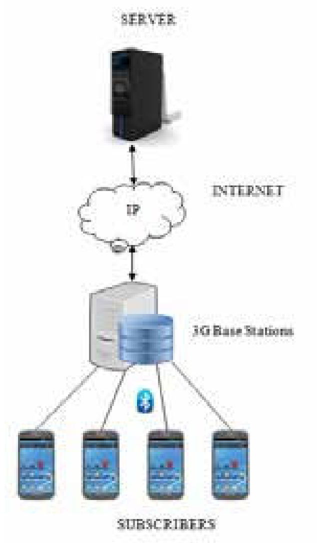

Fig. 2 Architecture of Optimal Pricing

3. Simulation results

In this section, we show the equilibrium of the video-stream redistribution under different scenarios.

We set the co-ordinate of the secondary buyer as (0m, 0m), and the subscribers are uniformly located within the range of [50m, -50m] in both x-axis and y-axis. The maximal transmit power P_{max} is 100mW, the noise level is 10^{-8} W, and we select the capacity gap γ=1, band width W=1MHz, the gain weighting factors g_Q=0.1, g_D=0.1/ms, and the cost per unit of power for each subscriber ci is a realization of an uniform random variable within [0.05, 0.15]. The processing delay of each subscriber, D_p(i), is a realization of an uniform random variable within [0.1, 10.1] ms. we use the video sequence "Akiyo" in QCIF format and H.264 vodeio codec. The resulted rate- distortion parameter β=0.0416, and α =6.8449. We set the maximal PSNR which is provided by the original content owner be 35 dB, and the corresponding maximal bit-rate for Akiyo is 84kB/sec.

We model the redistribution behavior and analyze the optimal strategies of both subscribers and the secondary buyer who is willing to purchase the redistributed video stream. From the simulation results the secondary buyer will tend to buy more power from the subscribers with better channel to maximize his/her utility, and if the total number of the subscriber's increases, the secondary buyer can obtain a large utility value and the payment to each subscriber shrinks, due to more severe competitions among the sellers. Nevertheless, the service provider should always offer high-quality video stream to avoid competition with such a redistribution network.

Fig. 3 Optimal video stream price versus qualities of network and streaming service

4. Conclusion
In this paper, we propose a kalman theory approach for the optimal price setting over mobile video streaming networks. We aim to investigate the optimal price of the mobile video stream redistributed by the subscribers.

5. Future references
In forward we can able to develop the authorized person was sent the content to the un-authorized person the content provider need to be know remotely and he need to be sent intimation reference to that particular un-authorized person.

This entire procedure has to be done remotely with particular charges range.

REFERENCES

1. G. Gualdi & A. Prati, and R. Cucchiara, “Video streaming for mobile video surveillance” | 2. D.F.S Santos & A. Perkusich, “Granola: A location and bandwidth aware protocol for mobile video on-demand systems” in International Conference on software, Telecommunications and Computer Networks, 2008. | 3. S. Sudin, A. Tretiakov , R.H.R.M. Ali & M.E. Rusli (2008) “Attacks on mobile networks: An overview of new security challenge” in International Conference on Electronic Design. | 4. G. Owen (2007) “game theory”, academic press, 3rd edition. | 5. Heejung Lee, Yonghee Lee, Jonghun Lee, Dongeun Lee, and Heonshikshin (2009) “Design of mobile video streaming system using adaptive spatial resolution control” IEEE transactions on consumer electronics. | 6. G. Aniba & S. Aissa, “A general traffic and queuing delay model for 3G wireless packet networks” Lecture notes in computer science. | http://www.itu.int/itud/ict/statistics/ict/graphs/mobile.jpg. |