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Layered video multicast with a P2P cooperation approach

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ABSTRACT

With the rapid development of wireless networking technology, real time video multicast applications have become feasible. These applications are bandwidth hungry and have stringent delay constraints. Furthermore, in wireless networks, different users generally have different receiving capabilities. Therefore, it is challenging to provide scalable support for such applications. To address this challenge, in this paper, we propose to use layered video and a P2P mode approach. In our solution, a video is encoded into multiple layers and broadcast to the multicast group users. Users form a P2P network to recover the loss of multicast video packets. This can significantly improve the overall received video quality. More importantly, our solution can provide incentives for users to help each other. With the proposed scheme, when a user helps another one, it can also improve its own received video quality.

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1. Introduction

With the rapid development of wireless communications, video applications have become more and more important. People can now watch online videos on their handheld devices.

However, in a wireless network, it is challenging to stream a video simultaneously to a large number of users in an efficient manner. Video multicast is an efficient way to deliver one video simultaneously to many users over wireless networks. Compared to unicast, it improves bandwidth efficiency by sharing video packets delivered through networks. But it faces some particular problems arising from wireless network applications.

In general, users in a wireless network can often have diverse channel conditions. This poses a great challenge to wireless video applications. For multicast application, the same video packet will be broadcast to all the users in the multicast group. A higher transmission rate will make the user with a poor channel condition unable to decode the received video packets. On the contrary, a lower transmission rate will waste the channel resources.

To meet the different channel quality, people have applied layered videos for video multicast applications (Li et al., 1998; Du and Zhang, 2009; Kim et al., 2005; Shi et al., 2006; Kim et al., 2008; Liu et al., 2004). With layered videos, a video is encoded into multiple layers. To decode a higher layer, all layers lower than this layer have to be available. It is challenging to choose an appropriate modulation-coding rate to meet the requirement of different users in a multicast session.

In this paper, we propose to use a P2P approach for video multicast applications in wireless networks. With our approach, users in a muticast group will form a P2P network and recover lost video packets in the broadcast channel. Now, more and more devices are equipped with multiple interfaces, e.g., the popular iPhone has 3G, WiFi and Bluetooth. A device with multiple interfaces provides the opportunity for P2P mode operation.

Our solution has the following key characteristics:

- *Incentives for user cooperation*: With layered video, more received video packets in the order of their importance lead to higher video quality. Our solution exploits this property, together with a tit-for-tat-like strategy, to provide incentives for cooperation. Specifically, each peer measures its received video packets from its neighbors, and reciprocates by helping this neighbor. Using this mechanism, when the video is sent at a higher rate and cannot support all users with the full video rate, the users with better channel conditions will help the users with poor channel conditions. Therefore, the video can be multicast at a higher rate, resulting to better received video quality.
- *Graceful video quality degradation*: With layered video, lost packets in an enhancement layer do not affect the decoding of lower layers. Our proposed chunk requesting and scheduling schemes give higher priority to more important layers.

The rest of the paper is organized as follows. In Section 2, we describe our network models. Section 3 presents our P2P approach solution. The simulation results are given in Section 4. In Section 5, we presents the related work. Section 6 concludes the paper. In this paper, we do not consider energy constraint at each peer.

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