sult, MuVi employs a near-optimal resource allocation algorithm to maximize the total system utility by intelligent resource allocation (e.g., frame dropping) and PHY rate adaptation of each video packet. MuVi does not require packet reception reports or perform re-transmissions. Instead, MuVi incorporates CINR reports that are available in current cellular networks to adjust the OFDMA resource allocation and PHY rate adaptation. Thus it does not require modification at the client-side or the air interface, and has minimum control overhead.

Scalable video multicast in wireless systems: In [13], Deb *et al.* studied the problem of multicasting scalable video (SVC) in WiMAX cellular networks with the goal of maximizing the system utility. They developed a greedy algorithm to allocate radio resources and adaptively assign the MCS for each transmitted video layer. In [16, 17], the authors use dynamic programming approach to find the optimal system utility and to assign modulation and coding schemes for scalable video traffic in mobile cellular networks. In [18], Li *et al.* considered joint-layer resource allocation to further improve multicast performance and developed approximation algorithms to trade off algorithm complexity with performance. All these works were only evaluated through theoretical analysis and simulations based on fixed layering sizes. The dynamics of video traffic across different video frames were not considered and no system implementation has been conducted.

Channel-unaware wireless video transmission: A couple of recent works proposed wireless video encoding and transmission schemes that need not be aware of the wireless channel conditions. SoftCast [14] proposed a joint channel encoding and video source coding scheme for mobile video transmission. This is essentially an analog approach for delivering video over the wireless. FlexCast [8] modified the MPEG4 video codec and incorporated rateless coding for efficient video streaming in wireless systems. Neither SoftCast nor FlexCast requires any feedback about the wireless channel conditions. The received video quality automatically adjusts depending on the channel quality at the clients. As a result, these two schemes provide natural support for wireless video multicast although they are not specifically designed for it. Nevertheless, both SoftCast and FlexCast require heavy modifications to video source coding, the air interface, and the mobile clients. By contrast, MuVi does not require any changes in these elements. MuVi requires long-term channel feedback and optimizes the video multicast transmission via efficient radio resource allocation and frame prioritization under the existing video and wireless standards. Thus it allows speedy deployment.

8. CONCLUSION

This paper presents MuVi, a wireless video multicast scheme in OFDMA-based cellular networks. We design and implement MuVi using a WiMAX testbed to show its efficacy in real systems. MuVi incorporates the clients' channel feedback and different video frame priorities to adapt the MCS for each video packet. MuVi's efficient resource allocation scheme helps to optimize the overall video quality in the multicast group. MuVi also allows providing differentiated services among users in the multicast group by assigning different utility to different users for the same packet while optimizing the overall video quality in the multicast group. MuVi does not modify the video encoding nor the wireless transmission schemes. Instead, it only involves resource allocations along with video frame prioritizations. MuVi is also applicable to other OFDMA-based wireless technologies (such as LTE and LTE-Advanced) and it does not require any modifications at the mobile clients, so it is readily deployable with commercial off-the-shelf devices.

Acknowledgments

We thank our shepherd, Dr. Thyaga Nandagopal, for his guidance through the camera-ready submission process. We thank Rajesh Mahindra from NEC Labs for invaluable support and suggestions during the preparation of this work. Jongwon Yoon and Suman Banerjee have been supported in part by the following grants of the US National Science Foundation: CNS-1040648, CNS-0916955, CNS-0855201, CNS-0747177, CNS-1064944, and CNS-1059306.

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