Announcing the Final Examination of Fei Xie for the degree of Doctor of Philosophy

Time & Location: April 22, 2010 at 3:00 PM in HEC 356
Title: A ROBUST WIRELESS MESH ACCESS ENVIRONMENT FOR MOBILE VIDEO USERS

The rapid advances in networking technology have enabled large-scale deployments of online video streaming services in today’s Internet. In particular, wireless Internet access technology has been one of the most transforming and empowering technologies in recent years. We have witnessed a dramatic increase in the number of mobile users who access online video services through wireless access networks, such as wireless mesh networks and 3G cellular networks. Unlike in wired environment, using a dedicated stream for each video service request is very expensive for wireless networks. This simple strategy also has limited scalability when popular content is demanded by a large number of users. It is desirable to have a robust wireless access environment that can sustain a sudden spurt of interest for certain videos due to, say, a current event. Moreover, due to the mobility of the video users, smooth streaming performance during the handoff is a key requirement to the robustness of the wireless access networks for mobile video users.

In this dissertation, we focus on the robustness of the wireless mesh access (WMA) environment for mobile video users. Novel video sharing techniques are proposed to reduce the burden of video streaming in different WMA environments. We propose a cross-layer framework for scalable Video-on-Demand (VOD) service in multi-hop WiMax mesh networks. We also study the optimization problems for video multicast in a general wireless mesh networks. The WMA environment is modeled as a connected graph with a video source in one of the nodes and the video requests randomly generated from other nodes in the graph. We formulate the optimal video multicast problem in such environment as two sub-problems and propose our solutions. The proposed solutions are justified using simulation and numerical study. In the case of online video streaming, online video server does not cooperate with the access networks. In this case, the centralized data sharing technique fails since they assume the cooperation between the video server and the network. To tackle this problem, a novel distributed video sharing technique called Dynamic Stream Merging (DSM) is proposed. DSM improves the robustness of the WMA environment without the cooperation from the online video server. It optimizes the per link sharing performance with small time complexity and message complexity. The performance of DSM has been studied using simulations in Network Simulator 2 (NS2) as well as real experiments in a wireless mesh testbed. We have used the Mobile YouTube website (http://m.youtube.com) as the online video website in the experiment. Last but not the least; a cross-layer scheme is proposed to avoid the degradation on the video quality during the handoff in the WMA environment. Novel video quality related triggers and the routing metrics at the mesh routers are utilized in the handoff decision making process. A redirection scheme is also proposed to eliminate packet loss caused by the handoff.

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Approved for distribution by Dr. Kien A. Hua, Committee Chair, on March 20, 2010.

The public is welcome to attend.