Video Performance Analysis in the UCSB MeshNet Testbed

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***Abstract*— Due to the inherent characteristics of wireless communication, it is difficult to support high quality real-time audio and video streams, particularly in multihop wireless networks. Factors such as channel contention, interference, and access latency add delay and degrade the quality of the stream. In this demo, we utilize the UCSB MeshNet testbed to study the ability of a mesh network to support multimedia streams. We investigate the impact of path length and background traffic on the quality of live video streams. We stream video from a video server, located at the demo location, through the Internet, across a pre-determined path within the UCSB MeshNet, and then back through the Internet to the video client at the demo location. As the video is played on the video client, the impact of different mesh network configurations can be observed. Monitoring utilities allow us to quantitatively study the characteristics of the video at the ingress and egress points of the UCSB MeshNet.**

I. Introduction

A mesh network consists of wireless mesh routers that form a (typically static) multihop backbone. The network can provide wireless end nodes access to services in a manner similar to a wireless LAN. Since a mesh network is not dependent on any pre-existing communication infrastructure, it has greater deployment flexibility than other types of networks. However, the multihop nature of the mesh network results in challenges related to link variability, interference and channel contention.

In this demo, we examine the performance of streaming video through the use of our UCSB MeshNet testbed[1]. Through the streaming of video from the demo location through our testbed, we investigate, both qualitatively and quantitatively, the received quality of the video stream. Although the packets traverse the Internet as well as the MeshNet, the effect of the MeshNet on the video stream typically dominates that of the Internet. Hence the perceived quality of the video is affected by changes in the mesh network configuration. We vary the network configuration and the traffic load within the UCSB MeshNet to study the effect of these parameters on the overall quality.

II. System Architecture

The UCSB MeshNet consists of 25 nodes equipped with IEEE 802.11b radios. The nodes are distributed on five floors of the Engineering 1 building on the UCSB campus. The purpose of the testbed is to evaluate protocols and systems designed for the robust operation of multihop wireless networks. For the demo tests, we utilize small formfactor off-the-shelf Intel Celeron 2.4GHz machines running Linux version 2.4.20.

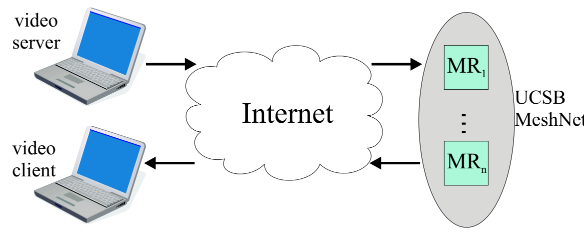

Fig. 1. System Architecture.

Our demo architecture consists a virtual private network (VPN) that encompasses both the video client and server, as well as the testbed nodes. The VPN is utilized to ensure that the video captured at the server is transmitted across the Internet and through the UCSB MeshNet. The video is captured at the demo location using the Video LAN streaming utility[2]. It is then packetized and transmitted over UDP through the VPN along a pre-configured route within the UCSB MeshNet. A set of configuration scripts allows us to dynamically modify the path within the network and add or remove background traffic. The video traffic leaves the UCSB MeshNet from the specified egress point and then travels back through the Internet to the video client, which is also a member of the VPN. The video is then played at the video client and the quality is affected by any delays or packet losses that occurred en route. Figure 1 illustrates the architecture of our video transmission system.

To quantitatively evaluate the packet reception quality and to isolate the performance impact of the mesh network, we place a monitoring utility at both the ingress and egress points of the UCSB MeshNet. Our monitoring utility captures the frame arrival rate and interframe spacing of the video packets. This enables the measurement of packet loss rates, delay and jitter that results from the mesh network. All three of these values should be minimized for optimal video quality. We plot real-time graphs that illustrate the results of these measurements.

[1]http://moment.cs.ucsb.edu/meshnet. The testbed was funded through NSF Network Research Testbeds (NRT) grant ANI-0335302 as part of the WHYNET project.

[2]http://www.videolan.org