

Demo Abstract: Evaluating Video Delivery over Wireless Multicast

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Abstract—The lack of adequate support for multicast hinders the ability of WiFi to deliver high quality video in crowded areas with large number of users. In our recent papers, we presented techniques for low-overhead feedback collection and rate adaptation for WiFi multicast. In this demo, we present a platform for evaluating video delivery over multicast using these techniques. The platform does not require changes in existing 802.11 standards and we implemented it on Android devices and laptops. The platform allows evaluation of the performance of multicast feedback, rate adaptation, and video rate adaptation algorithms in various settings including mobility and external interference.

Keywords— *WiFi Multicast, Video Streaming, Mobile, Performance Evaluation*

I. INTRODUCTION

With high quality video streaming constituting an ever larger fraction of network traffic, the wireless access networks have become a major bottleneck. Multicast offers a scalable and cost-effective solution for video delivery to large groups of users interested in similar content (e.g., in sports arenas, entertainment centers, and large events). However, WiFi networks provide limited multicast support at a fixed low rate without any feedback mechanism and this limits its practicality and reliability for high-quality content delivery. There is a need for a practical and scalable multicast system that *dynamically adapts the transmission rate*.

High quality multimedia delivery using multicast has received considerable attention (see [1] for a survey). For example, Medusa [2] uses a pseudo-multicast based approach that uses MAC layer feedback to set backoff parameters and application layer feedback for link-layer rate adaptation. DirCast [3] is a proxy-based multicast solution that focuses on intelligent client-Access Point (AP) association, tuning of FEC, etc. However, existing approaches do not consider the impact of large number of receivers and may suffer from low throughput in the presence of a few users with very poor channel quality.

Recently, we presented the Adaptive Multicast Services (AMuSe) system for content delivery over WiFi multicast to a large number of users [4]. AMuSe includes an efficient feedback mechanism [5] and a multicast rate adaptation algorithm (MuDRA) [6]. AMuSe is well-suited for Adaptive Bit-Rate

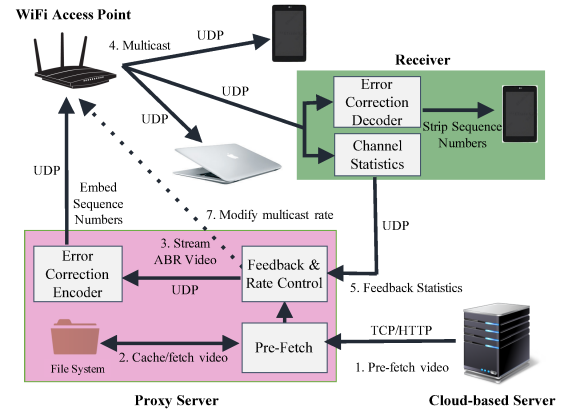


Fig. 1. Mobile platform for evaluating wireless multicast delivery with: (i) multicast proxy, (ii) the WiFi Access Point, and (iii) receivers.

(ABR) video streaming in which a video file is segmented to chunks and each chunk is encoded in several video rates. At each time slot, a chunk with an encoding rate determined by a video rate adaptation algorithm is transmitted. In [7] we presented a trace-based tool to demonstrate the performance of AMuSe on 200 nodes on the ORBIT testbed.

In this demonstration, we present a *mobile platform* for evaluating the performance of video delivery over wireless multicast. We implement multicast feedback, rate adaptation, and video rate adaptation methods developed in [5], [6] on the platform. The platform supports the evaluation of the impact of mobility and interference on video quality. Moreover, it allows studying the impact of various parameters on video performance such as the sensitivity of rate adaptation to noise.

While we implement a particular set of feedback, multicast rate, and video rate adaptation algorithms for the ease of exposition, the current design is highly extensible to evaluate other schemes including cross-layer optimization of wireless and video rates, and error correction for wireless multicast. We highlight some of the algorithms in Section II and describe the architecture of the platform in Section III.

II. ALGORITHMS OVERVIEW

We implement the following algorithms on the platform:

(i) **Multicast feedback scheme** dynamically selects a small set of well-distributed nodes as *feedback nodes* to reduce the feedback overhead [5]. The feedback nodes periodically update the AP about their service quality, e.g., RSSI, Packet Delivery Ratio (PDR), and throughput.

(ii) **Multicast rate adaptation mechanism** can identify the optimal rate in a dynamic environment that maximizes the channel utilization while meeting performance guarantees [6]. The rate adaptation mechanism avoids the need for packet retransmissions.

(iii) **Error correction**: We utilize simple error correction techniques to recover from packet losses.

III. MOBILE PLATFORM ARCHITECTURE

The platform consists of 3 main components (Fig. 1):

(i) **Multicast Proxy**: The multicast proxy caches videos locally for subsequent transmission to receivers. It is responsible for maintaining statistics based on feedback reports from the nodes selected by the feedback algorithms [5]. The proxy also selects multicast rate and video encoding rate using an algorithm such as *MuDRA* [6]. The segments are transmitted to the WiFi AP as UDP packets¹. Finally, the proxy handles error corrections at the application-layer. This could include adding forward error correction schemes such as Raptor codes [8] or retransmission of segments with too many packet errors.

(ii) **WiFi Access Point**: We use a commercial off-the-shelf WiFi AP which supports open source firmware such as DD-WRT. The AP runs the ath10k driver which is modified to support multicast rate changes through application layer calls.

(iii) **Receiver**: The receivers listen to the UDP video stream packets. Each packet is first passed to the error-correction decoder which stores and decodes a block of packets and forwards it to the media player. The receiver also calculates statistics such as the percentage of packets received, RSSI, and video buffer levels which are sent to the multicast proxy based on feedback protocol negotiated between the receivers and the proxy.

IV. DEMONSTRATION

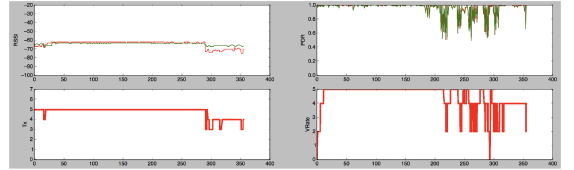
Setup: Fig. 2(a) shows the demo setup. It consists of the components described in Section III. The multicast proxy and the server is hosted on a laptop. The multicast receivers are a number of Nexus 7 tablets and couple of laptops. The AP is a TP-Link Archer C7 device with our custom drivers.

Experiments: The setup allows to evaluate the performance of video delivery over multicast on mobile devices in real settings. Besides being able to visually compare the quality of the video, a monitor attached to the multicast proxy will provide performance statistics of the performance at nodes. A sample feedback with 2 Android tablets serving as feedback nodes is shown in Fig. 2(b).

¹The UDP packets have an embedded sequence number in the payload to keep track of the received packets at the receivers.



(a)



(b)

Fig. 2. (a) The demo setup with the multicast proxy (left), WiFi Access Point, and 3 clients - 2 Android tablets and one laptop (right), (b) The statistics at the proxy server from 2 feedback nodes including the RSSIs, Packet Delivery Ratios, multicast rate, and video rate.

V. ACKNOWLEDGEMENTS

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