CS244 PA3 Intermediate Project Report

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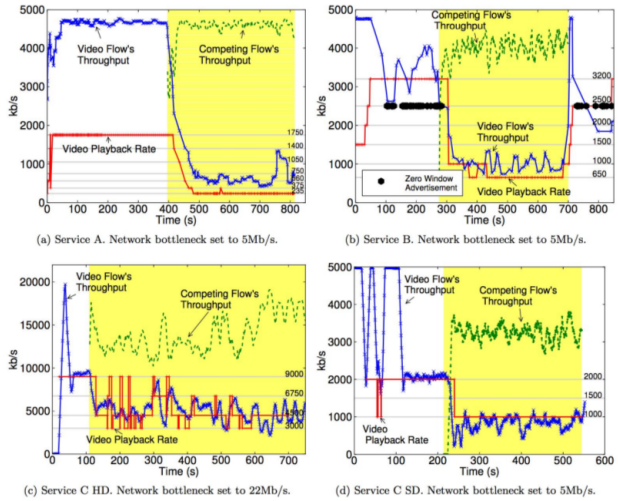
2017-04-27

1 Introduction

We chose to replicate results from Confused, Timid, and Unstable: Picking a video streaming Rate is Hard This paper provides insight into picking the video streaming rate for video streaming over HTTP. Generally, commercial video streaming services must implement a bit-rate selection algorithm on the client side: clients constantly estimate bitrate and use this signal to adapt their rate. However, inaccurate bitrate selection, especially in the presence of competing flows, can trigger a phenomenon called the "downward spiral effect", in which the video player gets much less bandwidth than its fair share, leading to low quality of experience. The authors analyze the root cause of this effect, and propose and evaluate several remedies including average filtering on the estimation as well as less conservative bitrate selection algorithm.

We have chosen to try to replicate the "downward spiral" effect in the services tested by the original authors. This is shown in Fig.4 of the original paper, shown below. We chose these figures as they represent the core findings of this paper – that some video streaming clients cut their bit-rates too aggressively in the presence of competing flows, leading to playback rates and throughputs which are much lower than the fair share.



(a) Service A. Network bottleneck set to 5Mb/s.

(b) Service B. Network bottleneck set to 5Mb/s.

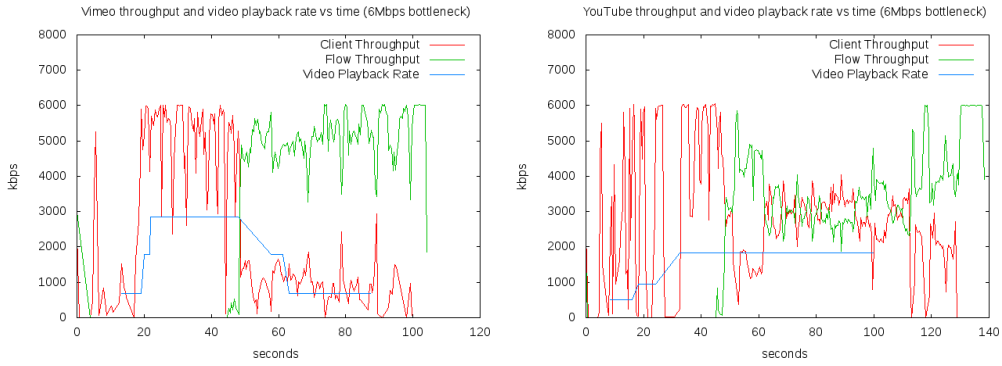
(c) Service C HD. Network bottleneck set to 22Mb/s.

(d) Service C SD. Network bottleneck set to 5Mb/s.

If time allows, we will also try to replicate the results of streaming using modified clients, which use solutions proposed by the authors for the "downward spiral" issue. These are presented in figures 20 and 21 of the original paper.

2 Progress so far

So far, we have generated graphs similar to Figure 4 of the original paper for YouTube and Vimeo. As shown below, YouTube's player does not exhibit the downward spiral effect, while Vimeo's player does. We chose to start with examining these services, rather than Netflix or Hulu (which are the services examined in the original paper) since they are freely accessible without a subscription and there exist third party tools such as `youtube-dl` for manipulating video downloads from these sites.



(a) Vimeo's player shows a downward spiral effect

(b) YouTube's player does not show a downward spiral effect

Figure 1: Throughput and video playback rate for popular video streaming service clients in the presence of a competing flow

To do this, we set up an environment which uses `mahimahi` to set up the network conditions outlined in the paper (a bottleneck link of 5Mbps with a 120kb buffer). Additionally, we use the metering functionality of `mahimahi` to track throughput of the video stream and the competing flow.

We use Firefox's developer tools to track HTTP requests made while the player is running. We save these requests and process them to extract the video playback rate for the client. Unlike the use of `mahimahi`, which can be easily applied to new streaming services, determining the playback rate of the client requires custom parsing and analysis to be performed for each streaming service independently.
To assist with this, we use `youtube-dl`, which can parse DASH manifests of some video streaming websites (though, notably, not Netflix or Hulu), which we use to map the HTTP requests made during the playback to one of the rates enumerated in the DASH manifest. We also use `youtube-dl` to set up a competing TCP flow to the video streaming server and directly download the video being streamed.

3 Plan for the next weeks

We plan to generate graphs shown above for Netflix and Hulu. Most of the approach we have used until now will carry over without modification to these services. However, we will need to find a replacement for `youtube-dl`, and will have to write custom parsing to back out the video streaming rate from HTTP requests made by the clients.

If time allows, we will implement the solutions to the downward spiral effect discussed in the paper and test them against video streaming services which have clients that exhibit a downward spiral. Finally, we plan to conduct sensitivity analysis on our results, varying the characteristics of the bottleneck link and the competing flows to examine how these effect the formation of a downward spiral.