

Assignment 5: Download Rate Prediction Algorithm

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1 The Question

This assignment is motivated by actions taken by an HTTP Live Streaming client that is attempting to determine the highest quality segment it can download under the current network conditions without risking a playout buffer underrun.

The goal of this assignment is to design an algorithm that based on the download rates of previous segments determines the maximum request rate that guarantees the next segment will be downloaded in time with 95% confidence. The only fundamental requirement is that the algorithm periodically downloads a non trivial (more than a few packets) block of data, measures the rate of transmission, and based on this and all past download rates, makes a prediction of the maximum rate to be expected during the next download. If the actual rate is more than the prediction, the algorithm succeeded, otherwise it fails. The goal of the algorithm is to achieve 95% success rate or better. To discourage intentional picking of low rates to ensure success, the ratio of measured and predicted rates is reported.

2 Introduction

The algorithm chosen is a high range moving average with a scaling factor. This was chosen for two reasons. The first is that a moving average will be more reactive for changing network conditions, if they were to occur. Secondly, the high range was chosen because networks tend to converge to a rate for a period of time before changing. The scaling factor was included in order to have the algorithm succeed with 95% confidence, and is discussed further below.

3 Experiment

The file being downloaded is a dummy 1MB file created using the `dd` shell command. It is downloaded 1000 times, with the algorithm predicting the next download rate after each download is completed. The moving average range is 50 downloads. All downloads were over the private IPv4 interface between RB1 and RB2.

4 Results

Table 1 shows the results of these experiments with different scaling factors. The time to download the file is not included here, as it is not pertinent to the algorithm’s success.

Scaling factor	Algorithm Success Rate	Network Utilization
1.00	40.4%	100%
0.99	51.0%	99.2%
0.98	63.9%	98.2%
0.97	78.2%	97.3%
0.96	95.0%	96.0%
0.95	99.4%	95.1%
0.94	99.6%	94.3%

Table 1: Download rate prediction algorithm results

5 Discussion

The algorithm was not good enough on its own to achieve success with 95% confidence with network utilization close to 100%. However, if each prediction was then scaled back 4%, the algorithm performed to the desired specifications. The scaling factor adds an element of safety to ensure that the success rate is 95%, and it still maintains a high network utilization of 96.0%. If whoever was using the algorithm wanted even more confidence that the results were accurate, they could chose a scaling factor of 0.95% for a 99.4% success rate with a slight hit to network utilization.

6 Conclusion

With the scaling factor added, the algorithm performs to all specifications. Each prediction needs to be scaled back 4% to ensure confidence.