A Joint-Probability-Distribution Model for Bandwidth Estimation with Application to Live Video Streaming

- Current bw estimation/prediction methods are mostly predicting the value of future bandwidth.

- This has severe limitations, e.g., in live video streaming, if the actual bandwidth is lower than the predicted bandwidth then it will result in frame delay or frame drop.

- In many applications, it is desirable to be able to control the performance to given targets, e.g., video delivery rate over a given target percentage. This cannot be easily achieved via current bandwidth prediction methods.

- Propose the use of probability distribution to model future bandwidth. Specifically, we model future bandwidth using past data transfer observations/measurements, and then derive the probability model for use in the application.

- This enables the selection of application parameters in a probabilistic manner such that given target performance can be achieved.

- To further improve model accuracy, we propose to use joint-prob-distribution to correlate past and future bandwidth.

1. Introduction

Explain the importance of bandwidth/throughput prediction, as it has applications in many services such as video streaming.

Recap the common design of current approaches – predict a single value for future bandwidth.

Point out its limitations by showing some summary results, e.g., what would be the frame drop rate in live video streaming if such approaches were adopted. Saying we’re going to revisit this in detail in Section 3.

Propose the joint-prob-distribution model, explaining that it can be empirically constructed in an online manner. Provide some summary results again in live video streaming to show the potential performance gains.

2. Background and Related Works

2.1 Bandwidth prediction methods

(LSTM, ARIMA, our method, MA… )

3. Bandwidth Prediction Revisited

Develop a model for live video streaming to demonstrate the limitations of current methods.

- Single-value prediction has limitations with prediction errors.

- Discount-factor based approach, which is widely adopted in many ABR algorithms, does not have a formal way to optimize the discount factor, and thus cannot reliably achieve the performance target via simulation results.

4. Online Joint-Probability-Distribution Bandwidth Model

- Assume the dist is known, e.g., could be coming from a previous streaming session.

- What happens during the model building phase?

Analyze how much data collection is needed (in the context of the application) and what will be the performance evolution during that time.

- Progressive migration from baseline prediction to conditional distribution modelling.

5. Application to Live Video Streaming

- Comparison to current bw estimation methods.

- Need comparison to other existing algorithms on adaptive live video upstreaming.

6. Summary and Future Work