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Demo: Codec-Aware Video Delivery Over SDNs

Obinna Izima
Technological University Dublin, d17127923@mytudublin.ie

Ruairí de Fréin
Technological University Dublin, ruairi.defrein@tudublin.ie

Ali Malik
Technological University Dublin, ali.malik@tudublin.ie

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Obinna Izima, Ruairí de Fréin, Ali Malik
Technological University Dublin, Ireland

Problem

As video traffic continues to dominate the global IP traffic, there is a need to ensure good quality of video is delivered. Guaranteeing Quality of Delivery (QoD) is the primary concern of video service providers. One way to achieve this is by predicting video QoD.

How can the video QoD be predicted in a timely manner given time-varying network delays and bandwidth fluctuations? Given accurate predictions of the video QoD, how can these predictions be used to adaptively re-route the video path to preserve the video quality by avoiding congested paths?

Contribution

In this demonstration, we show how accurate the jitter predictions achieved by a new learning agent, Codec-aware Network Adaptation Agent (CNAA), are. We demonstrate the integration of the CNAA agent with an adaptive, centrally controlled SDN framework that re-configures network operational paths in response to the learning agent, ensuring that the video quality is maintained during periods of congestion.

We summarize our contributions as follows:

1. We develop a new jitter prediction algorithm which is called the Codec-aware Network Adaptation Agent (CNAA);
2. We develop a SDN reconfiguration component which consists of a path finding algorithm which chooses the set of edges which have the lowest failure rate;
3. We integrate the SDN controller with the CNAA predictor so that the integrated system adaptively re-routes the network operational paths and preserves the video quality. The reconfiguration model is built using Minievents and ZeroMQ so that the controller can adaptively re-route the video.

Figure 1. We draw jitter measurements using Wireshark from a video streaming session between a client (RHS) and a video server (LHS) in an SDN environment.

Results

The Proposed Framework

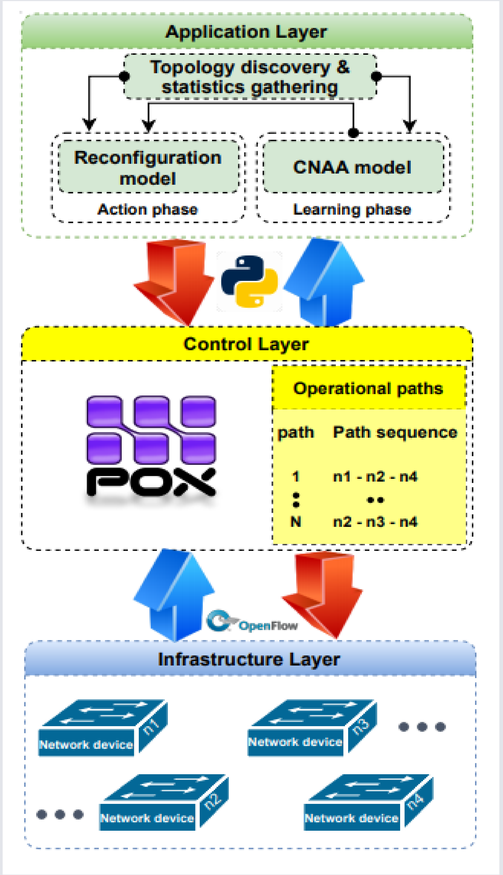

Figure 2.
System architecture and components: the primary contribution is the integration of the learning and action blocks.

Time Series Jitter

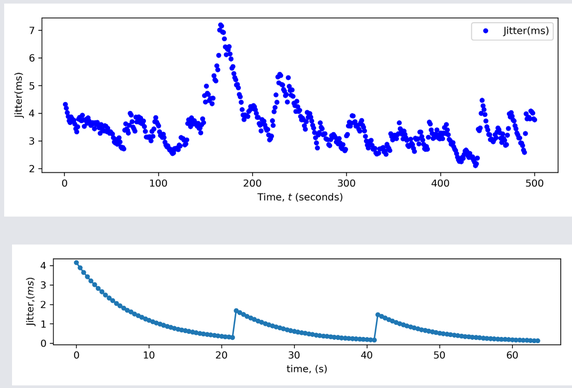

Figure 3.
Row 1 (R1) illustrates the adaptive behavior of the codecs in response to network congestion; Row 2 depicts an extract of the data in R1 showing the exponential shape of the curves.

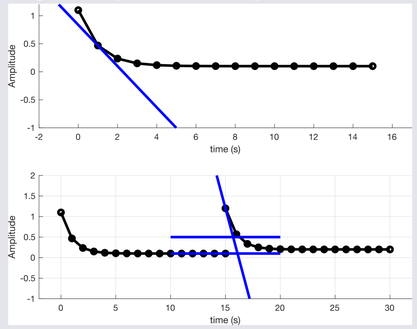

Figure 4.
Linear approximations of jitter time series yield inaccurate estimates of jitter values as they are not flexible enough to capture the characteristics of jitter time series.

CNAA [1]

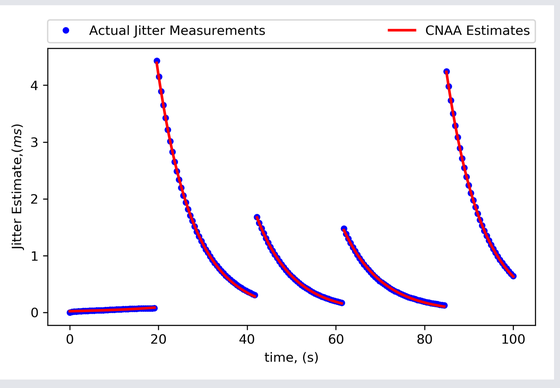

Figure 5.
Accuracy of the CNAA prediction model: The obtained predictions are overlaid on the jitter measurements.

Reconfiguration Model [2]

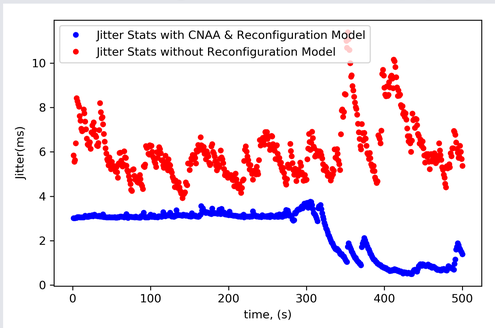

Figure 6.
Effect of the CNAA agent estimations and the SDN reconfiguration component: We record a 64% performance improvement in the jitter statistics.

Research Hypothesis

Machine Learning (ML) models that explicitly model network dynamics whilst developing predictors and monitoring agents for Quality of Delivery (QoD) metrics in video delivery networks offer more accurate predictions than those that do not.

In our previous work [3, 4], we presented evidence that demonstrated the effect of disregarding the load (the number of concurrent users in a video streaming session). These adaptive learning methods have lower computational complexity and yield more accurate predictions than approaches that ignored the presence of the load in the system. This demo is a first proof of concept that demonstrates how this type of learning can be applied in SDNs.

Acknowledgements

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