QoE-centric network path selection based on SDN

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ABSTRACT

Our work aims at developing a novel Software Defined Networking (SDN) platform that monitors the network and makes changes in the paths to achieve better performance in the network in case of video streaming. More specifically, the developed SDN packet loss controller periodically monitors a networking parameter on the video packets transmission path and collects statistics, based on which, it performs network path selection. As a result, the Quality of Experience (QoE) for the end-users is increased, as compared to a standard SDN controller.

CCS CONCEPTS

Communication networks, Software-Defined Networking

KEYWORDS

SDN, Video streaming, Quality monitoring, Mininet

1 Proposed SDN Controller

SDN provides the ability to make control related decisions centrally, which transforms legacy network devices to simple forwarding elements. In this new architecture, the decisions are taken from an application that acts as a strategic control point in the network and manages the flow control for improved network management and application performance.

Our work aims at developing an SDN platform (POX) that monitors the network in ***real-time*** and makes ***dynamic*** changes in the paths to achieve better performance in the network in case of video streaming. Therefore, the decisions for video packet routing are taken periodically and dynamically. Our SDN packet loss controller monitors the video packets' transmission and collects statistics, based on which, it calculates on-the-fly a value that is used to change the forwarding path if needed. Next, the QoE metric Peak to Signal Noise Ratio (PSNR) is calculated.

For the purposes of our experiments, we have created a Mininet topology using a custom Python script. Using the MiniEdit GUI, we can visualise the tested topology (Figure 1). According to the topology, host h1 in Mininet VM will send packets to h2 via switches s1, s2, s5. By default, the packets will follow the shortest path to reach the destination. Therefore, the main path that will be followed for sending packets from h1 to h2 is h1→s1→s2→s5→h2. The alternative path will be h1→s1→s3→s4→s5→h2.

Our proposed packet loss SDN monitor operates as follows: If the packet loss rate value in the main path is above a predefined threshold, then the alternative path is selected for sending the packets instead of the main path. The packet loss rate is calculated only in the main path, and it is the sum of the packet loss rates in all links of the path. The controller communicates with the switches in order to collect information from them and also change or add configuration information to them through statistics events. To achieve this, it sends statistics requests to the switches and receives statistics replies from them. After calculating the packet loss rate, the controller changes the forwarding rule according to the packet loss rate in the main path.

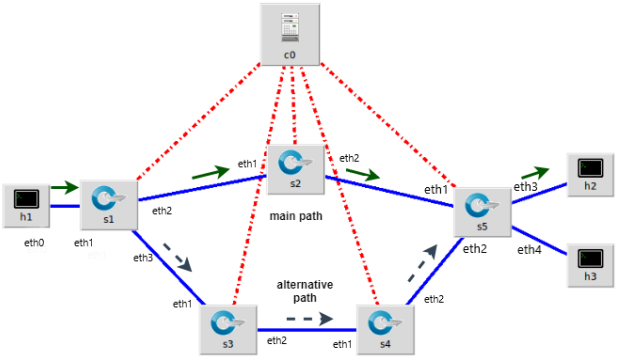

Figure 1. Testbed emulated topology and possible routes.

2 Evaluation

The experiments that we have executed study the impact of varying packet loss in a link in the integrated SDN-based emulator. To prove the added value of this new controller, we execute the experiments running a) the de-facto, i.e., default POX-controller with its stock components, and b) the proposed POX component. We create video streaming traffic in our emulation based on the FFMPEG tool. Figure shows the comparison between the cases with and without the proposed SDN packet loss controller in video traffic generation with bandwidth 100Mbps in terms of PSNR, showing an important increase in PSNR values with the proposed controller, and therefore an expected increase in the user's QoE. Although the emulated topology is quite simple, it could be extended to a more complicated one, imposing, however, higher overhead in the network due to the monitoring process.

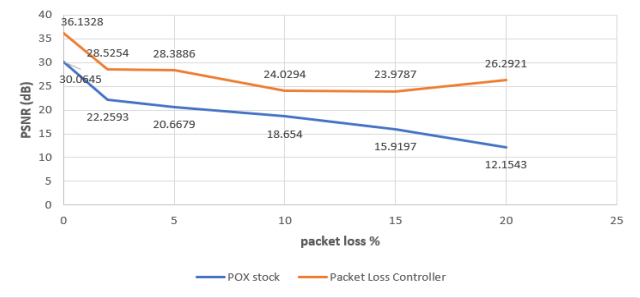

Figure 2. PSNR values' comparison.

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