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Estimation of Adaptation Parameters for Scalable Video Streaming over Software Defined Networks

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Abstract

Scalable Video adaptation is process of extracting the scalable video levels, which can be realized by technologies such as Software Defined Network and Content Aware Network, where devices are capable of processing packets based on the content that flows through them. The main challenge involved in the adaptation process is building the prior knowledge required for deciding the number of scalable layers. This paper implements Scalable Video streaming over a Software Defined Network. From this work, we derive the prior knowledge required by the controller to identify the adaptation parameters for different network conditions and video types.

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Keywords: Scalable Video Coding; Software Defined Networks; Video Streaming; Future Internet; Content Aware Networking; Video Adaptation;

1. Introduction

Multimedia communication is becoming more popular and common in Internet communication as it increases the effect and comfort of the communication. In general, multimedia content is large in volume and the cost of media storage and translation is still significant. The exponential growth in consumer demand for streaming of high definition content has inevitably lead to the development of a number of technologies in video coding and networking. The content can be streamed either live or on demand depending on the requirement of the users. The popularity of streaming media has led to the development of plenty of streaming applications for the people who use hand-held devices such as tablets and smart-phones for daily use.

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On the whole, a network that connects multiple devices has different Network and processing technologies. A network in which devices having different operating systems and protocols interact with one another is termed as a heterogeneous environment. In addition to this, a variety of network technologies make a network heterogeneous. This results in the improvement in reach-ability of such devices with a reduction in technology costs. The streaming of videos when it comes to a heterogeneous network poses challenges and can be explained with the diagram shown in Fig. 1. The change in the technology from one network to another affect the quality of video i.e. streamed, because of packetization and fragmentation delay and bandwidth variations.

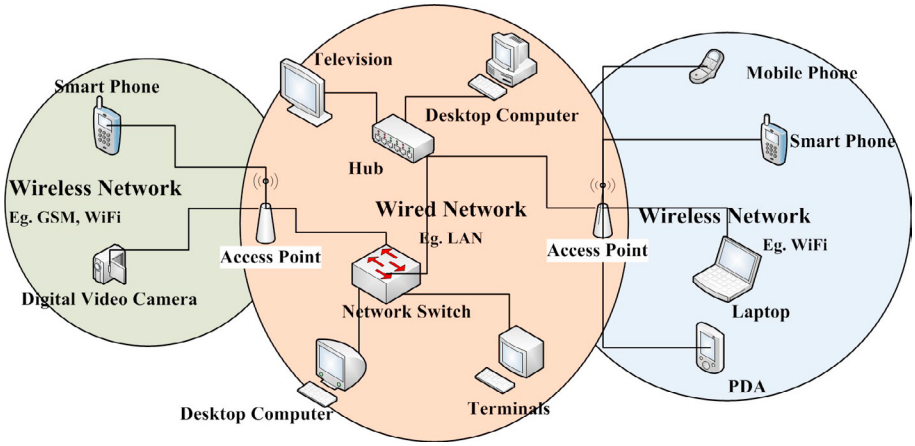

Fig. 1: An example for heterogeneous network

It has been observed that there is a need for global topology information to reduce end-to-end delay and packet loss. This will help in improving QoS/QoE of the received video, resulting in the user being comfortable and satisfied. Software-defined networking (SDN) [1] is an example of one such technology that provides a global view of the network and central decision taking system. This property of SDN enables the QoS/QoE improvement in video communication in the heterogeneous environment.

Layered video coding [2] offers a solution to the problem of supplying multiple streams in order to meet the requirements of heterogeneous users. Scalable video coding (SVC) [3] is an extension of H.264/AVC [4] and implements layered video coding. SVC codes video into layers initiating with the base layer, containing the lowest level of detail spatially in terms of temporal resolution (frame per second) and from a qualitative perspective. Additional layers can enhance the quality of the video stream with the increase in resolution using either any or all of these variables along with the base layer. A video can be termed as scalable when there happens to be a possibility to enhance or eliminate parts of the stream, such that the resultant sub-stream gets structured into another vaild stream of data for another target decoder. This will help in effective usage of network resources and also improve the efficiency of the communication [5, 6].

The heterogeneous requirements of a user and the network constraints are addressed by SVC. Adaptation is the process of extracting the scalable layers to meet the user requirements based on network and terminal constraints. This can be implemented at the server, receiver, and in-network, but in-network will have a better impact on network resource usage and QoS of the video streamed. In-network adaptation can be implemented by intermediate networking devices such as routers and switches. These devices need to have some intelligence to understand the scalable video parameters, network dynamics, terminal device capabilities and user requirements. The Future Internet Architecture proposes a CAN and CCN enabled intelligent intermediate device, which is named Media Aware Network Element (MANE).

SDN and SVC together can help in refining the QoS/QoE of video communication [7]. In-network adaptation [8, 9] of the SVC is possible through SDN technology, where SDN controller implements the MANE. This enables the adaptation of videos based on the requirements of the user as well as the availability of network resources. As an SDN controller would have global knowledge of network topology along with resource availability, it could decide the number of layers needed to be transmitted to a destination.