

Chapter 71

DASH: A Solution for Improving Video Delivery Quality in Heterogeneous Network Environments

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ABSTRACT

Multimedia streaming has major commercial potential as the global community of online video viewers is expanding rapidly following the proliferation of low-cost multimedia-enabled mobile devices. These devices enable increasing amounts of video-based content to be acquired, stored, and distributed across existing best effort networks that also carry other traffic types. Although a number of protocols are used for video transfer, a significant portion of the Internet streaming media is currently delivered over Hypertext Transfer Protocol (HTTP). Network congestion is one of the most important issues that affects networking traffic in general and video content delivery. Among the various solutions proposed, adaptive delivery of content according to available network bandwidth was very successful. In this context, the most recent standardisation efforts have focused on the introduction of the Dynamic Adaptive Streaming over HTTP (DASH) (ISO, 2012) standard. DASH offers support for client-based bitrate video streaming adaptation, but as it does not introduce any particular adaptation mechanism, it relies on third party solutions to complement it. This chapter provides an overview of the DASH standard and presents a short survey of currently proposed mechanisms for video adaptation related to DASH. It also introduces the DASH-aware Performance-Oriented Adaptation Agent (dPOAA), which improves user Quality of Experience (QoE) levels by dynamically selecting best performing sources for the delivery of video content. dPOAA, in its functionality, considers the characteristics of the network links connecting clients with video providers. dPOAA can be utilised as a DASH player plugin or in conjunction with the DASH-based performance-oriented Adaptive Video Distribution solution (DAV) (Rovcanin & Muntean, 2013), which considers the local network characteristics, quantity of requested content available locally, and device and user profiles.

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INTRODUCTION

Video delivery over the Internet is experiencing an outstanding growth. It is expected that the “video-on-demand traffic will nearly triple by 2017” (Cisco, 2013b, p. 2), while a sharp increase of up to 16-fold is predicted for mobile video between 2012 and 2017 (Cisco, 2013a). Among the many areas in which the online distribution of video content is expanding, education is one of the most important. Production of educational video content is becoming inexpensive and efficient (e.g. lecture podcasts, student generated videos, etc.) and it is easily made available online. Free educational video content is provided by many institutions, including Coursera (Coursera, n.d.) and edX (edX, n.d.). Increasing network connection support (e.g. wired and wireless connections such as WiFi as well as third and fourth Generation of mobile phone mobile communication technology standards - 3G/4G) together with processing power of mobile computing devices has led to their regular use for video retrieval and viewing. Decreasing costs of such devices has resulted in an explosion in the number of users and bandwidth demands. Such prolific use of portable devices is changing many aspects of today’s life, including education, where millions of learners use diverse viewing devices to access and interact with online educational media content on a daily basis. This increase has added pressure on the network resources and solutions were needed to prevent negative effects of network congestion on user perceived quality or Quality of Experience (QoE) levels. Among the various solutions proposed, video delivery mechanisms which adapt the content to meet available network bandwidth, reduce loss and increase user QoE are very successful (Muntean & Murphy, 2002).

Dynamic Adaptive Streaming over HTTP (DASH) (Stockhammer, 2011; ISO, 2012) has been proposed to address problems with traditional approaches to streaming to a variety of Internet Protocol (IP) connected devices. DASH is a scalable client-based solution offering support for

adaptive video streaming by enabling consecutive downloads of short video segments to match the viewer’s current delivery conditions. It supports dynamic bitrate switching and live media services. This relatively new standard leverages existing HTTP-based multimedia content delivery infrastructure without the need for specialised media servers. Similar proprietary solutions such as Microsoft Silverlight Smooth Streaming (Zambelli, 2009), Apple HTTP Live Streaming (HLS) (Pantos, 2012) and Adobe Dynamic HTTP Streaming (HDS) (“Adobe HTTP Dynamic Streaming,” n.d.) are widely used. However, DASH is a step towards standardised, cross-platform, efficient and cost-effective media streaming to a variety of IP enabled devices ranging from smartphones and tablets to PCs, TVs and set-top boxes.

In this chapter, we provide a short description of the DASH standard as it is considered the industry’s most advanced standard for streaming multimedia content (Fisher, 2013). We also compare a number of current DASH-aware solutions in terms of the initial delivery delay control and throughput estimation. Furthermore, this chapter presents a DASH-based solution – DASH-aware Performance Oriented Adaptation Agent (dPOAA) and illustrates its benefits in an educational setting.

BACKGROUND

Currently Hypertext Transfer Protocol (HTTP) (Fielding et al, 1999) video streaming is a topic which attracts significant level of interest in the field of multimedia communications (Begen, Akgul, & Baugher, 2011). This complements the many existing solutions which were designed for video streaming over the Internet. Video streaming applications require real-time and steady throughput that is provided with efficient flow and rate control mechanisms. Real-time Transport Protocol (RTP) (Schulzrinne, Casner, Frederick, & Jacobson, 2003) is one such protocol and it is

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