VIEWPORT-DEPENDENT 360 DEGREE VIDEO STREAMING BASED ON THE EMERGING OMNIDIRECTIONAL MEDIA FORMAT (OMAF) STANDARD

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ABSTRACT

360 degree video streaming has gained much interest recently. The Omnidirectional MediA Format (OMAF) standard, currently in development by the Moving Picture Experts Group (MPEG), standardizes means for storage and delivery of 360 degree coded video based on a well-established standards ecosystem. This demonstration system uses the viewport-dependent OMAF media profile in which visual content within the current viewport is transmitted and displayed in higher fidelity than content outside the viewport to exceed the visual fidelity of viewport-independent solutions. This is achieved by dividing the video frame into tiles and using HEVC motion-constrained tile set (MCTS) encoding at multiple resolutions.

Index Terms— HEVC, MCTS, OMAF, 360 video.

1. INTRODUCTION

Virtual Reality (VR) has lately gained significant industry attention. While gaming is seen as a primary use case, 360 degree video consumption is considered as another major application and is expected to be ubiquitous in the near future. The delivery and decoding of high-resolution 360 degree videos in desirable quality is a challenging task due to network limitations and constraints on available end device. In an intent to harmonize VR platforms and provide interoperability, MPEG (ISO/IEC JTC 1/SC 29/WG 11) has started work on the Omnidirectional MediA Format (MPEG-OMAF) standard. Currently, OMAF supports coded video up to a conformance point of HEVC Main 10 profile, Main tier, Level 5.1, as 4K video at 60fps is a typically supported operation point in high-end mobile phones. OMAF defines viewport-independent and viewport-dependent media profiles. With the viewport-independent media profile, the rendered HMD viewport covering 90°x90° would result in a resolution of roughly 1Kx1K per eye. However, this solution does not provide satisfying visual fidelity considering that state-of the-art HMD display panels already present up to 1.5Kx1.5K per eye to the user.

The demonstration described herein uses the viewport-dependent media profile from OMAF based on tile streaming. With tile streaming, it is feasible to offer the 360 degree video divided into tiles and at varying fidelity. The tiles are independently encoded in HEVC as motion-constrained tile sets (MCTS) and can therefore be recombined on demand depending on the current client viewport. The full resolution tiles are accompanied by a 1:2 downsampled version at half resolution with aligned tiling. By dynamically combining tiles at varying resolution, a bitstream conforming to HEVC Main 10 profile, Main tier, Level 5.1 can be delivered to the end device with the viewport at a resolution beyond 1Kx1K.

Figure 1 illustrates the components of the demo system. The combination of the mixed resolution tiles can be carried out by using the extractor feature of ISO base media file format (ISO/IEC 14496-15) as specified in OMAF. On client side, a single HEVC bitstream can be recreated by simply playing the respective file format tracks. OMAF metadata that describes the projection format for the purpose of rendering is contained in the respective file format boxes and passed to the rendering component as well as carried within the HEVC bitstream itself. It is worth noting that substantial coding efficiency gains of up to 30% BD-Rate were reported for tiled streaming over viewport-independent streaming of 360 degree video using the Equirectangular Projection (ERP). Besides ERP, OMAF also supports the Cubemap Projection (CMP) in the viewport-dependent media profile.

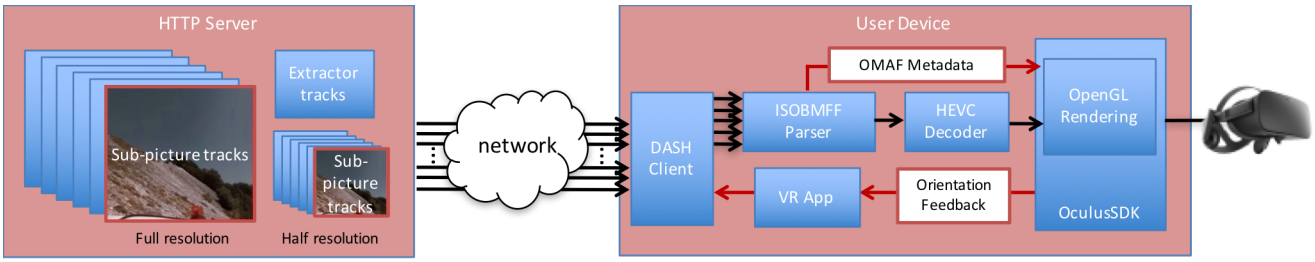

Figure 1: OMAF viewport-dependent demo system overview.