Pano: Optimizing 360° Video Streaming with a Better Understanding of Quality Perception

Yu Guan, Chengyuan Zheng, Xinggong Zhang, Zongming Guo Junchen Jiang

SIGCOMM ’19, Beijing, China

Overview

In this paper, the authors came up with a novel system dealing with 360 videos. The traditional FOV system used a uniform tiling scheme to split the whole video into small tiles and encode them in multiple quality levels. However, Pano proposed a variable-sized tiling scheme to leverage its QoE model for 360 videos. The QoE model can evaluate each small tile and group tiles with similar quality together to form a larger tiling scheme. By reducing the number of tiles, Pano can reduce the size of the video chunks while not losing QoE.

Pros:

- Quality model for 360 videos: this model takes into consideration some 360 video-specific factors: relative viewpoint-moving speed; change in scene luminance; the difference in depth-of-field (DoF). By introducing the quality model, Pano can have a better understanding of where to invest the most bits.
- Variable-sized tiling scheme: compared with traditional tiling scheme, it can be more efficient while not losing too much perceived quality.
- Good deployability: Pano extends DASH and doesn’t need any change on the server-side. Deployability is a huge advantage in real life. Especially for 360 video systems that try to reuse the existing system for delivering 2D videos.

Cons:

- Weak validation: To validate the performance, they only ran a survay-based evaluation of 20 participants. The evaluation of QoE of 360 videos can be really subjective so a large group of participants needed to get an unbiased result.
- More calculations: even though the authors proposed calculating efficiency scores offline, it still requires more calculating in the run time to groups all the pixels together. The more pixels the 360 video has, the heavier the operation will be.

- Quality model: the model Pano used is relatively simple, currently. It only takes the difference of pixels into consideration. A more complicated model may be needed to perfectly evaluate all the three quality-determining factors they mentioned.

Improvements

- To leverage more of the quality model, an object recognition model may be needed instead of grouping based on quality score. Or at least for the main object in one frame.
- When viewers watch videos, sometimes they may need to pause the video to see more details. Or even adjust the playback speed to clearly see what happened in a short period time. In this case, the assumption will change. For example, far depth-of-field doesn't mean users are less sensitive to the quality distortion. Instead, the users pause the video on purpose to see what's happening in the background. Pano may need to take some tricks to solve this problem.