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Crowdsourced MultiView Live Video Streaming using Cloud Computing

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Multi-view videos are composed of multiple video streams captured simultaneously using multiple cameras from various angles (different viewpoints) of a scene. Multi-view videos offer more appealing and realistic view of the scene leading to higher user satisfaction and enjoyment. However, displaying realistic and live multiview scenes captured from a limited view-points faces multiple challenges, including excessive number of precise synchronization of many cameras, color differences among cameras, large bandwidth, computation and storage requirements, and complex encoding. current multi-view video setups are very limited and based in studios. We propose a novel system to collect individual video streams (views) captured for the same event by multiple attendees, and combine them into multi-view videos, where viewers can watch the event from various angles, taking crowdsourced media streaming to a new immersive level. The proposed system is called Cloud based Multi-View Crowdsourced Streaming (CMVCS), and it delivers multiple views of an event to viewers at the best possible video representation based on each viewer's available bandwidth. CMVCS is a complex system having many research challenges. In this study, we focus on resource allocation of the CMVCS system. The objective of the study is to maximize the overall viewer satisfaction by allocating available resources to transcode views in an optimal set of representations, subject to computational and bandwidth constraints. We choose the video representation set to maximize QoE using Mixed Integer Programming (MIP). Moreover, we propose a Fairness Based Representation Selection (FBRS) heuristic algorithm to solve the resource allocation problem efficiently. We compare our results with optimal and Top-N strategies. The simulation results demonstrate that FBRS

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generates near optimal results and outperforms the state-of-the-art Top-N policy, which is used by a large scale system (Twitch). Moreover, we consider region based distributed datacenters to minimize the overall end-to-end latency. To further enhance the viewers' satisfaction level and Quality of Experience (QoE), we propose an edge based cooperative caching and online transcoding strategy to minimize the delay and backhaul bandwidth consumption. Our main research contributions are: We present the design and architecture of a Cloud based Multi-View Crowdsourced Streaming (CMVCS) system that allows viewers to experience the captured events from various angles. We propose a QoE metric to determine the overall user satisfaction based on the received view representation, viewers' bandwidth capability, and end-to-end latency between viewer and transcoding site. We formulate a Mixed Integer Programming (MIP) optimization problem for multi-region distributed resource allocation to choose the optimal set of views and representations to maximize QoE in constrained settings. We propose a fairness based heuristic algorithm to find near optimal resource allocation efficiently. We propose an edge computing based video caching and online transcoding strategy to minimize delay and backhaul network consumption. We use multiple real-world traces to simulate various scenarios and show the efficiency of the proposed solution.