Motivation

- Active deployment of triple and quadruple services by network operators delivering voice, real-time high-quality video, and value-added data services over converged networks (e.g., 4G).
- Need to guarantee subscribers’ Quality-of-Experience (QoE) and provide differentiated services in the face of heterogeneous end devices, varying wireless channels, resource constraints, etc.
- Lack of QoE orchestration models that map network events (e.g., variation in bandwidth, delay, error rates, jitter) to subscribers’ QoE.

State-of-the-Art in QoE

- Video Quality Attributes: Session quality (initial buffering, re-buffering, audio video synchronization), video quality (frame quality, frame-rate, stalling), and nature of the content contribute to user’ QoE.
- Several unreliable objective (e.g., PSNR, SSIM) and subjective metrics (e.g., MOS, VQM) to measure QoE
- Current Solutions: Bit-rate switching, feedback-based encoding, etc.
- Very little understanding of the major causes of user perceived degradation.

Evaluation Video Characteristics

- Sony Video
  - MPEG-4 VBR, frame size CIF 352 x 288
  - Video duration: 589 sec, 7681 frames, GoP size: 16
  - Average BW: 6.727 Mbits/sec, SD BW: 2.8 Mbits/sec
- Silence of the Lambs
  - MPEG-4 VBR, frame size CIF 32 x 288
  - Video duration: 1800 sec, 53953 frames, GoP size: 16
  - Average BW: 3.74 Mbits/sec, SD BW: 1.75 Mbits/sec

Bandwidth Provisioning Strategy & Evaluation Results

- Fixed BW Provisioning
  - Preset BW levels based on the source bit rate
  - Provision these bandwidths at fixed intervals depending on whether the current bit rate falls below or rises above the provisioned BW
- Dynamic BW Provisioning
  - Track cumulative moving average $\mu(t)$ and cumulative moving standard deviation $\sigma(t)$ of the source bit rate
  - Provision BW at fixed intervals such that
    - Provisioned BW for the next interval can withstand a variation of $\alpha$ times the SD of bit rate of the current interval
    - Estimated receiver buffer does not fall below a certain threshold $\beta$

$$BW(i+1) = \mu(t) + k \cdot \sigma(t) + \alpha / w - \beta \cdot \sum_{j=0}^{i} BW(j) - w \cdot \mu(i) / w$$

References