SUBJECTIVE EVALUATION OF HEVC/H.265 BASED DYNAMIC ADAPTIVE STREAMING OVER HTTP (HEVC-DASH)

Iheanyi Caleb Irondi*, Qi Wang & Christos Grecos, UWS, UK.
VIDEO STREAMING CHALLENGES

- Instability of the network due to limited bandwidth and dynamically changing WAN conditions.
- Support for HD, UHD and other systems with high bandwidth requirements.
- Video traffic dominates global consumer traffic.
- Adapting the video streaming session to user’s bandwidth condition.
- Integration of the latest video compression standard (H.265/HEVC) with DASH.
DYNAMIC ADAPTIVE STREAMING OVER HTTP (DASH)
MPEG DYNAMIC ADAPTIVE STREAMING OVER HTTP

- ISO/IEC adaptive streaming standard for dynamic adaptive delivery of high quality multimedia contents.
- Published as ISO/IEC 23009-1:2012.
- Transverses firewalls unlike RTP packets.
- Supports Content Distribution Networks (CDN) which provide localized edges.
- Makes use of existing internet infrastructures.
- Runs on popular HTTP protocol and does not need specialized servers.
MPEG DYNAMIC ADAPTIVE STREAMING OVER HTTP

- Employs a server/client approach.
- Different bandwidth representations of same video.
- Segmentation of the different bandwidth representations into chunks.
- Stored on the webserver.
- HTTP request from DASH client to HTTP server using HTTP get partial get commands.
- Receipt of xml file describing contents.
- Streaming video adapted to clients network condition.
- Streaming session controlled by the client.
Adaptive streaming of video chunks
(HIGH EFFICIENCY VIDEO CODING) HEVC/H.265 STANDARD

- Latest video compression standard.
- Substantial reduction in bandwidth requirement (~50%) at same picture quality when compared with it’s predecessor H.264/AVC.
- Increased use of parallel processing.
- Support for 8k UHD videos.
- Larger block structure up to 64x64 pixels which helps in achieving better efficiency.
INTEGRATION OF HEVC/H.265 WITH DASH
HEVC/265 BASED DYNAMIC ADAPTIVE STREAMING OVER HTTP

- **Objective metrics (PSNR, SSIM, VQM)**
  - Compares impaired video to source video using mathematical algorithms.
  - Does not reflect human perception of video.
- **Subjective metric.**
  - Consumers perception of quality.
  - Human subjects.
  - Rate video based on perception and Quality.
  - Evaluation of the Quality of Experience (QoE).
SUBJECTIVE EVALUATION

- No established standard test procedure for subjective evaluation of DASH.
- Existing methods not sufficient.
- Cyclical effects of known issues on DASH.
- Longer video sequence instead of 10s clips.
- Controlled environment.
- Real-time subjective evaluation.
SUBJECTIVE EVALUATION

Test bed
SUBJECTIVE EVALUATION METHODOLOGY

- Encoding and segmentation of video streams into chunks.
- Emulating variable packet loss ratio (1%, 3%, 5%).
- Emulating Variable delay (50ms, 100ms, 150ms).
- Investigating the impact of 2s and 10s video segment sizes.
- Longer video sequence.
- 10 volunteers.
- Controlled environment with 22” TV monitor.
- Use of Absolute Category Rating Scale (ACR)….ITU-T Recommendation P.910.
- Random order.
- Mean Opinion Score (MOS).
VIDEO SEQUENCES
**ACR Scale**

<table>
<thead>
<tr>
<th>5</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Good</td>
</tr>
<tr>
<td>3</td>
<td>Fair</td>
</tr>
<tr>
<td>2</td>
<td>Poor</td>
</tr>
<tr>
<td>1</td>
<td>Bad</td>
</tr>
</tbody>
</table>
EXPERIMENTAL RESULTS
SUBJECTIVE EVALUATION RESULTS

![MOS v Bandwidth Graph]

Mean Opinion Score (MOS)

Bandwidth (Mbps)

- 0.2
- 0.5
- 2
- 8

2s Video Segment
10s Video Segment
SUBJECTIVE EVALUATION RESULTS

MOS v Delay

- Mean Opinion Score (MOS)
- Delay (ms)
- 2s Video Segment
- 10s Video Segment
SUBJECTIVE EVALUATION RESULTS

MOS vs Packet loss ratio

Mean Opinion Score (MOS)

Packet loss ratio (%)
SUMMARY
SUMMARY

- Practical test bed for subjective evaluation.
- Subjective evaluation of the impact WAN characteristics on DASH.
- Compared performance between small and large segment sizes respectively.
- Longer segment sizes provide better compression.
- Shorter segment sizes switch easily in case of sudden drop in network quality.
- From the results, users had better QoE with the 10s segment videos.
- MOS was reduced with increasing value of impairments.
- .................Initial delay.
- .................Stalling during playback.
- .................Flicker.
- Trade-off?
WAYS OF STREAMING VIDEOS

- Progressive downloading

- RTP-based streaming

- Adaptive HTTP-based streaming.
  - HTTP is firewall friendly.
  - Support CDN which provide localized edges.
  - Client manages the streaming session where adaptation of bandwidth is done at the client.
WHY DASH?

- Different industry proprietary solutions for adaptive streaming.
  - Microsoft’s Smooth streaming.
  - Adobe’s HTTP Dynamic streaming (HDS).
  - Apple’s HTTP live streaming (HLS)

- Different manifest and segment formats.
- Device must support a corresponding proprietary client protocol in order to receive a content from each server.
- Interoperability between different servers and clients of various vendors.

- .........................Hence MPEG-DASH!!!!!!