How Live is Live Streaming over HTTP? Inferring Playback Delay from Server Logs

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Live streaming of “Summer Koshien”

* Summer Koshien is the largest sporting event in Japan.
* Live streaming service was provided for all of games with HDS/HLS.
* 38 nginx servers
* Users can watch games on PC and Smartphone browsers, and dedicated Android and iOS App.

<table>
<thead>
<tr>
<th>Period of time (days)</th>
<th># Log entries (billions)</th>
<th>Sent data (TB)</th>
<th>#TCP connections (millions)</th>
<th># Unique IPs (millions)</th>
<th>Peak Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>1.9</td>
<td>531.4</td>
<td>281.0</td>
<td>1.3</td>
<td>108Gbps</td>
</tr>
</tbody>
</table>
How live is live streaming?

- For HTTP based live streaming, there is playback delay, and the length of playback delay differs depending on the viewers.
- **How much playback delay is there?**
  - We are not sure.
  - If we want to measure it, it is expensive.
- Developing estimation method for each player’s playback delay from only Web caching server logs.
  - Length of playback delay
  - Distribution of playback delay length
  - What causes most impact playback delay
Inferential Method of Playback Delay

(a): segment file length = L
(b): client’s arrival time = 1/2 x L (average)
(c): startup buffering time = N x L
(d): downloading and decoding time = w

Playback Delay = (1.5 + N) x L + w

Algorithm 1 \( \Delta buf \) and \( \Delta playback\_delay \) calculation method when playing back the Nth segment:

1: \( N \leftarrow 1 \)
2: while \( N \leq \) End of request per view do
3: if \( N = 1 \) then
4: \( \Delta buf \leftarrow 0 \)
5: else
6: if \( T_{f(prev,s)} < T_{d(s)} \) then
7: \( \Delta buf \leftarrow 0 \)
8: else
9: \( \Delta buf \leftarrow T_{f(prev,s)} - T_{d(s)} \)
10: end if
11: end if
12: \( \Delta playback\_delay \leftarrow T_{d(s)} + \Delta buf + \Delta seg.\_len - T_{0(s)} \)
13: \( N \leftarrow N + 1 \)
14: \( prev\_s \leftarrow s \)
15: \( s \leftarrow s + 1 \)
16: end while

Calculate Playback delay for each view of request sequences from Server Logs
Results & Conclusions

- Segmentation and startup buffering are big factors in playback delay for HTTP based live streaming.
- The vast majority of the playback delays are within the range of mean ±2 segment lengths.
- Playback delay as measured from server logs and delay calculated by the proposed model are almost the same.