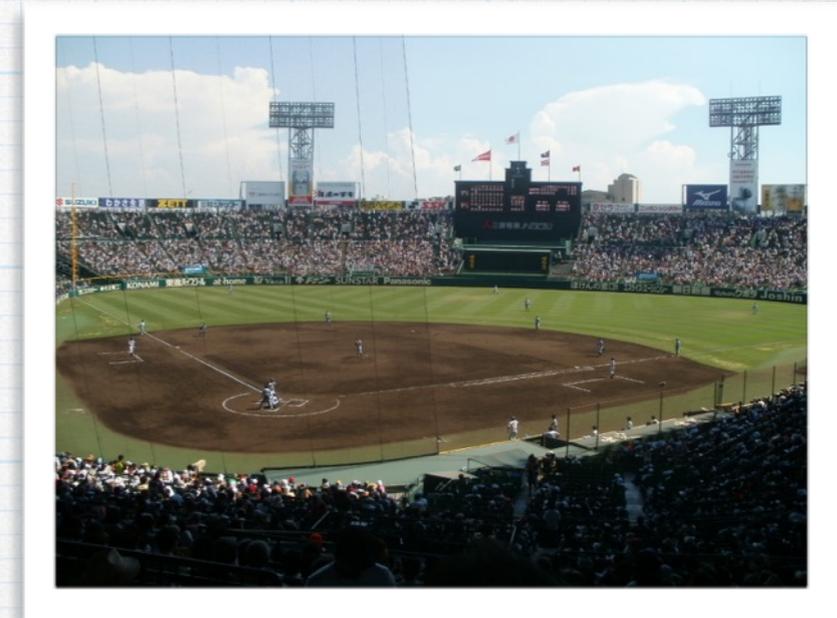


How Live is Live Streaming over HTTP? Inferring Playback Delay from Server Logs

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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.



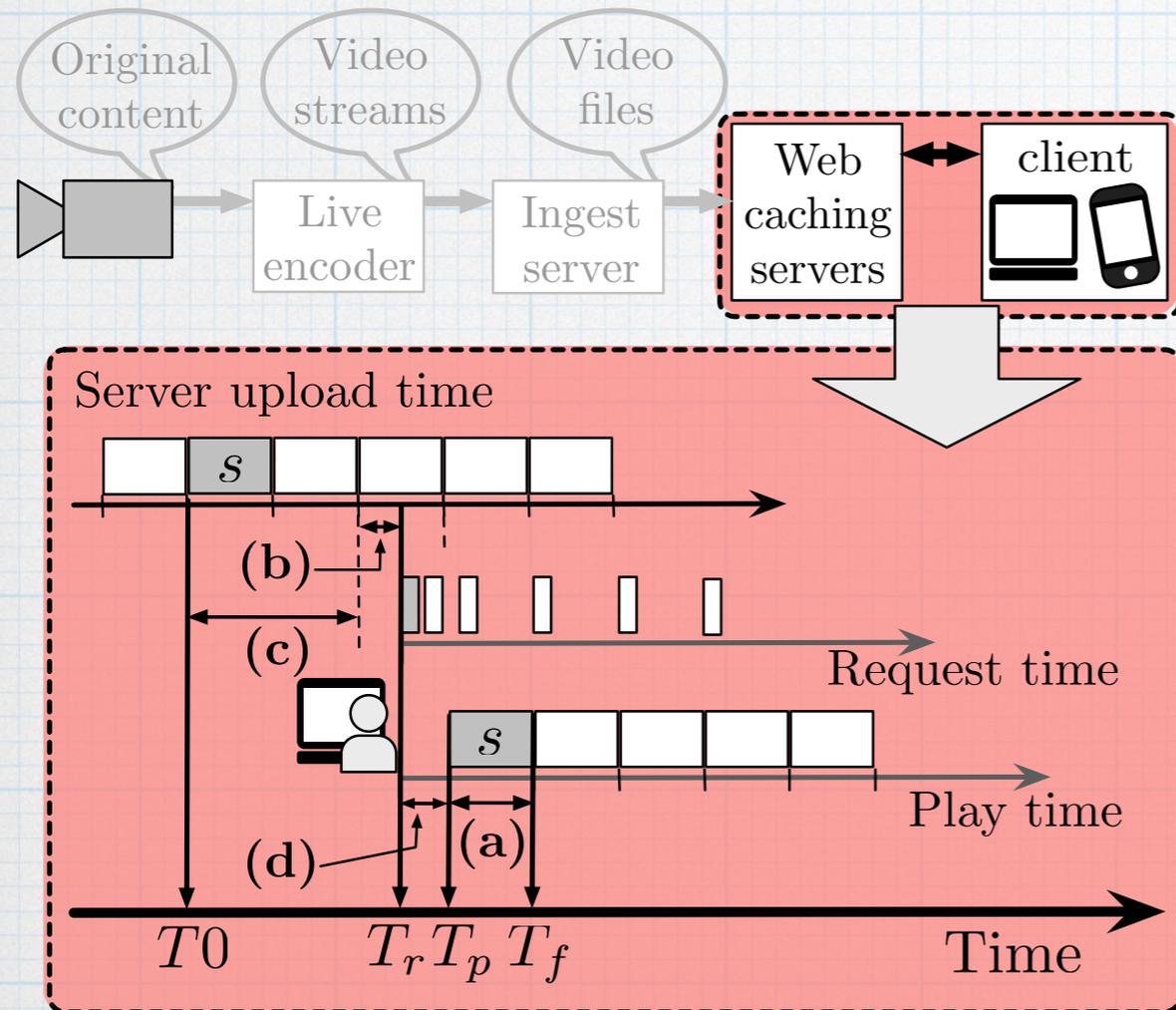
Koshien Stadium

Period of time (days)	# Log entries (billions)	Sent data (TB)	#TCP connections (millions)	# Unique IPs (millions)	Peak Traffic
14	1.9	531.4	281.0	1.3	108Gbps

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 = $1/2 \times L$ (average)
- (c): startup buffering time = $N \times L$
- (d): downloading and decoding time = w

$$\text{Playback Delay} = (1.5 + N) \times L + w$$

Algorithm 1 Δ_{buf} and $\Delta_{playback_delay}$ calculation method when playing back the N th segment:

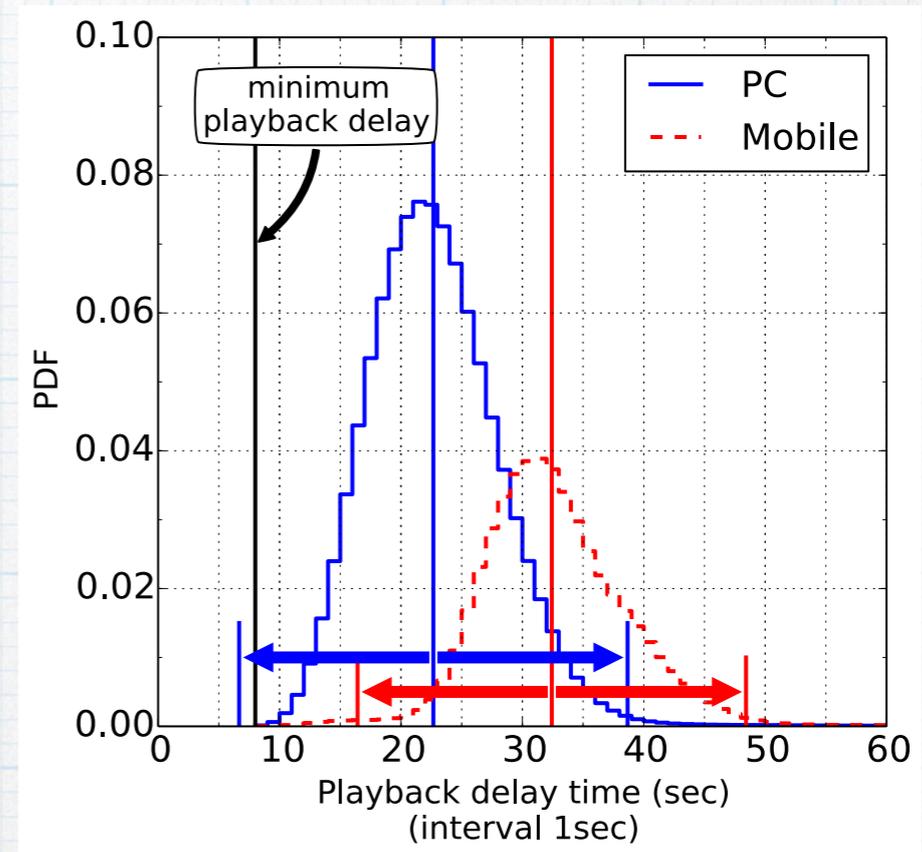
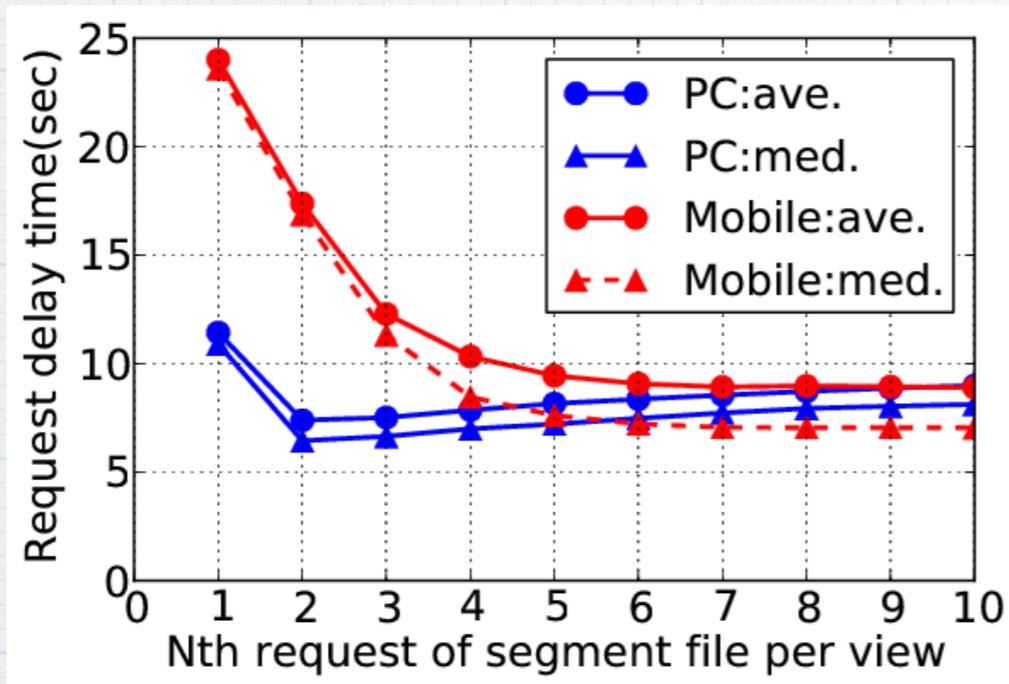
```

1:  $N \leftarrow 1$ 
2: while  $N \leq$  End of request per view do
3:   if  $N \equiv 1$  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:   $\Delta_{playback\_delay}$ 
13:     $\leftarrow T_{d(s)} + \Delta_{buf} + \Delta_{seg\_len} - T_{0(s)}$ 
14:   $N \leftarrow N + 1$ 
15:   $prev\_s \leftarrow s$ 
16:   $s \leftarrow s + 1$ 
17: 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.