Light Weight Video Fingerprints for Video Playback Verification in MPEG DASH

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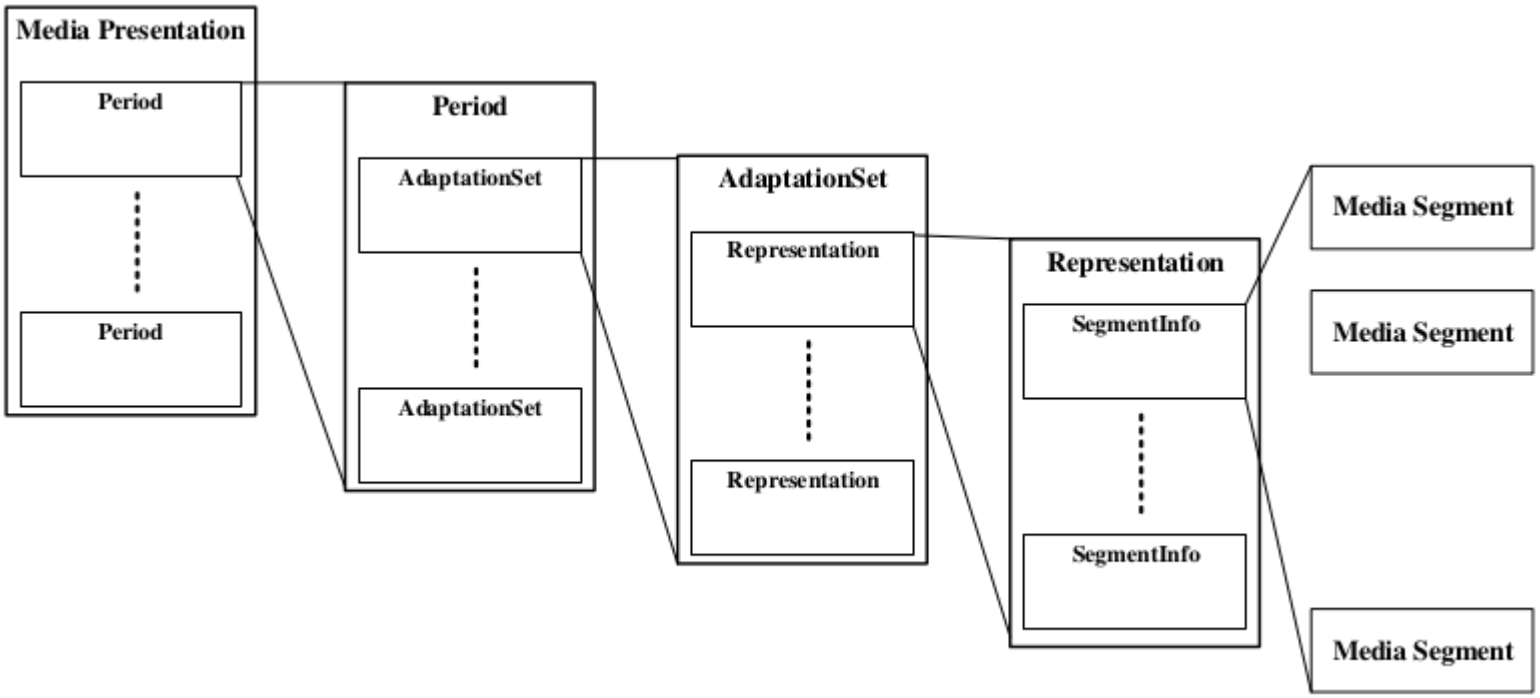
Outline

- Motivation
- Ads Playback Verification
- Light Video Fingerprint for Verification
- Simulation Results
- Conclusion & Future Work

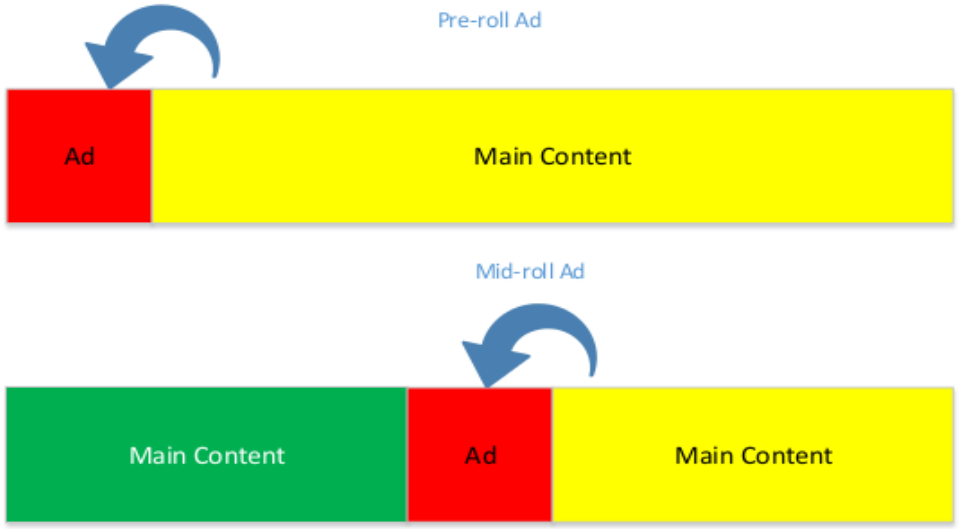
MPEG DASH System

- MPEG DASH Video System
  - Client “pull” based solution
  - HTTP Server with minimum intelligence on the server side
- MPD – Media Presentation Description



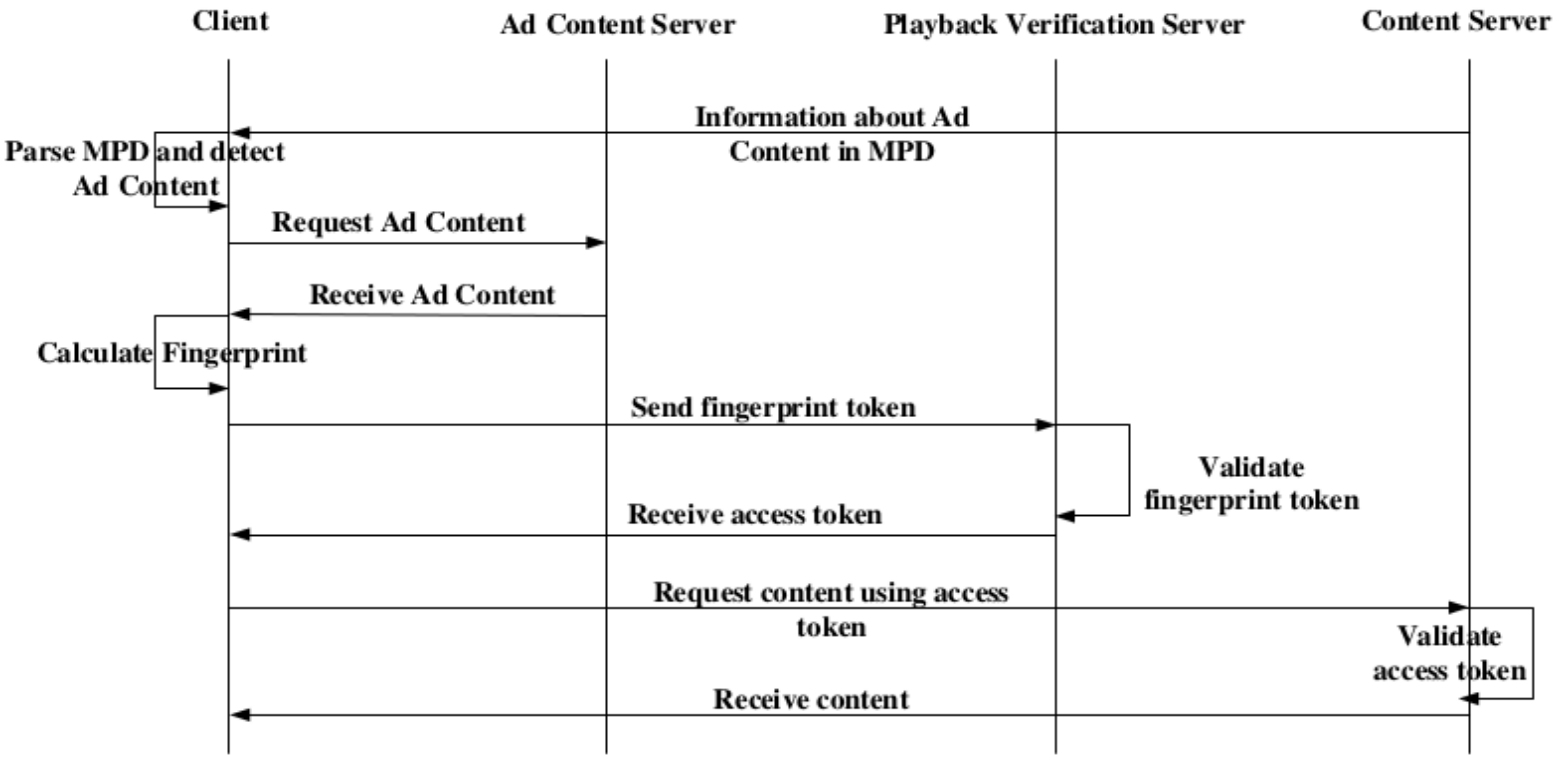
Ads in MPEG DASH

- Ads in DASH
  - Pre-spliced into the content
  - Period based Ads segments
- DASH is an open and client driven system, how to verify that ads are actually played out at the client ?
  - Create content period/segment serving dependence at the server



Playback Verification in DASH

- Introduce a playback verification server
  - Client playback the content, will compute a fingerprints and send to the server for verification



Challenges

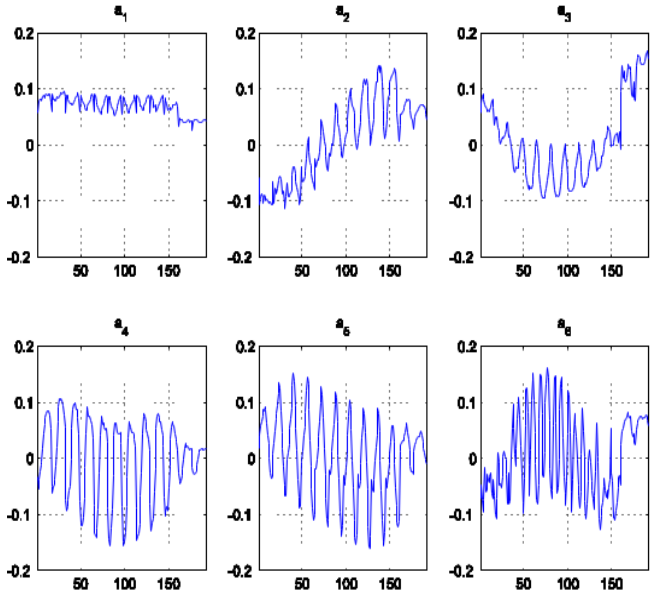
- The fingerprint extraction and verification should have minimum computational complexity for the client and verification server, such that the solution is scalable.
- The communication overhead of fingerprints should be very small
- Invariant to different rates of the ads period
- Should have very high True Positive Rate (TPR)
- The False Positive Rate (FPR) should be very low

Eigen Appearance Trajectory

- Motivated by the Eigenface work, bring video sequences to the Eigen appearance space

f_k

X



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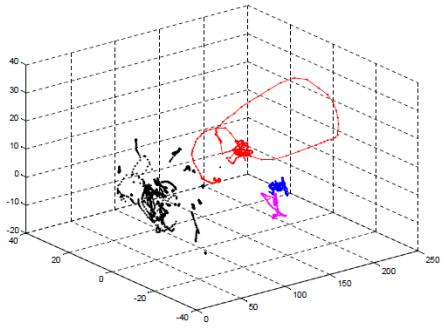
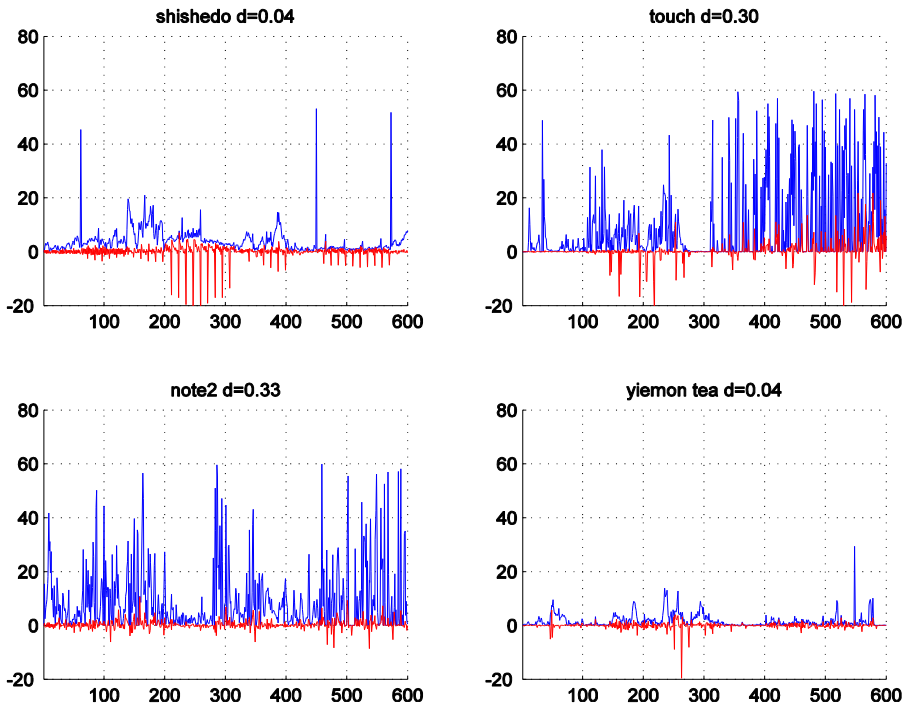


x_k

Differential Eigen-Appearance Signature

- Ads sequences are typically of high activities,
- The differentials of the Eigenappearance trajectories captures a very useful signature for verificaiton

$$dx(k) = \begin{cases} 0, & if\ k = 1 \\ Af_{k+1} - Af_k, & else \end{cases}$$

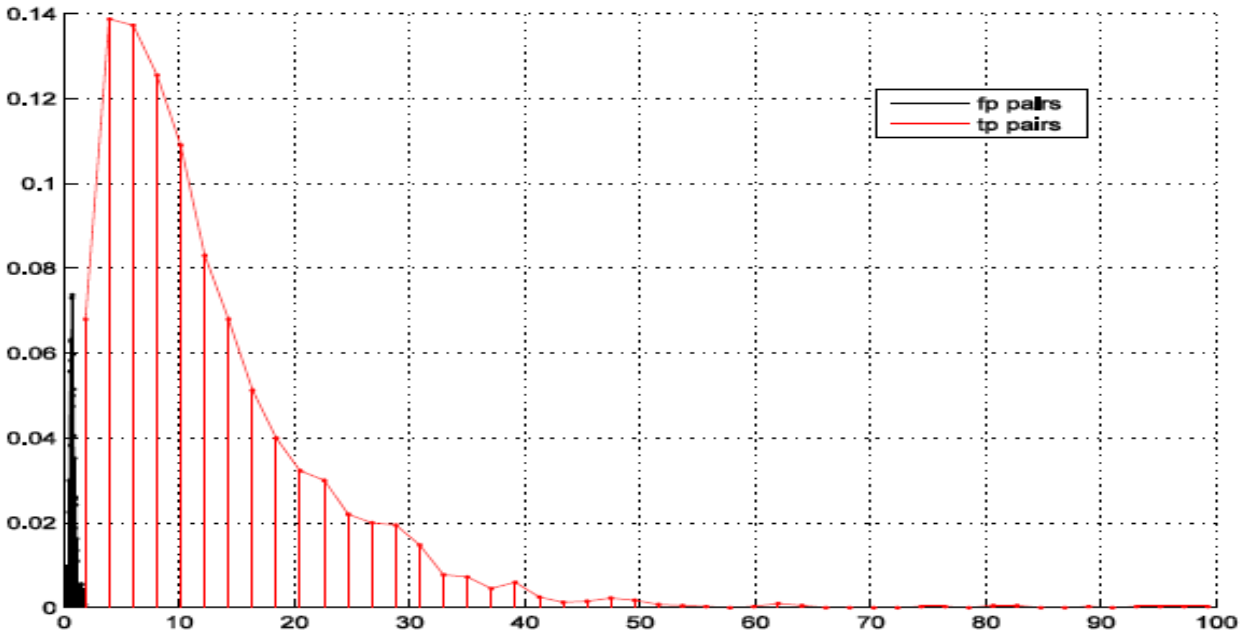


Fingerprints Verification

- Distance metric between two *m*-frame fingerprints

$$d(dx^1, dx^2) = \frac{1}{m}\sum_k (dx^1(k) - dx^2(k))$$

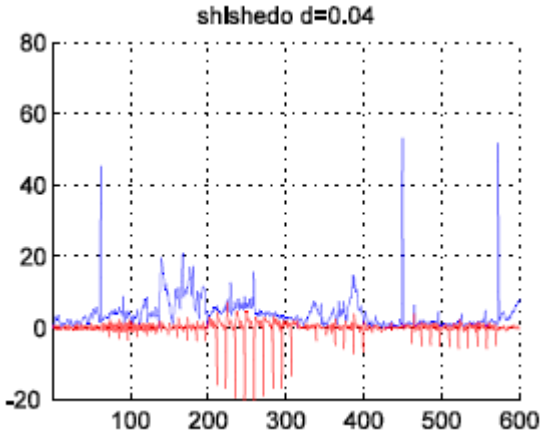
- Verification by thresholding on $d(dx^1, dx^2)$
  - Rejecting different sequences, whileccommodating rates variations



Noise suppression

- Ads sequences usually have many cuts

Shisheido



- Differential signature value at cuts are noisy, remove by,

$$dx(k) = \begin{cases} 0, & if\ k = 1 \\ d_{max}, & else\ if\ A(f_{k+1} - f_k) > d_{max} \\ A(f_{k+1} - f_k), & else \end{cases}$$

Simulation Setup

- Data Set:
  - 4000 ads clips of durations 15s, 30s and 60s
  - Simulating 3 DASH streaming rates: 480, 640, and 800kbps
  - 100+ hours of distraction video data sets from youtube, TRECVID, coded at various rates between 300kbps to 1mbps
- Probes set up, for each test ads sequence,
  - Positive probes: lower rates sequence probing 800kbps
  - Negative probes: randomly select 10 sequences from the distraction set

Simulation Results

- Signature Computing:
  - 1-d signature from 6-dim Eigen Appearance space
  - Approximately 200bits/sec for 25fps sequence, regardless of its frame size and bit rate, very small overhead
- Computation complexity
  - At client, less than 0.5% of ffmpeg decoding
  - At verification server, O(m), very small

Simulation Results

- Accuracy
  - For 100% TPR, i.e, no positive probes are rejected, the FPRs are,

	t=60s	t=30s	t=15s
R=640kbps	0.15%	0.52%	1.30%
R=480kbps	0.15%	0.60%	3.15%

Conclusion & Future Work

- Conclusion
  - Introduced a DASH video playback verification system and protocol
  - Developed a light weight, robust video fingerprints for video playback verification, the performance in accuracy is good, while at minimum computation and communication overhead
- In the future,
  - develop a binarized fingerprints for even faster verification
  - Automatic token hash generation

Q&A

- Questions….

Thanks/Gracias