Optimal Caching for H.264 Partitioned Video Streaming

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Outline

• Motivation
• Video profit model
• Profit for partitioned video
• Optimal video caching
Motivation

• Fast growing demand of video content versus limited storage capacity.
• H.264 Data Partitioning provides units with different importance.
• To identify the value of different video partitions and give them unequal priorities for being stored.
Video Caching at Proxies Close to Clients
Frame Types

- Key (IDR) Frame
- Predicted Frame
- Bi-predicted Frame
Partition Types

Partition A

Partition B

Partition C

Key (IDR) Frame

Predicted Frame

Bi-predicted Frame
PSNR Profit Model

Original video → H.264 encoder (JM) → H.264 decoder (JM) → PSNR of loss free video

Partition loss → H.264 decoder (JM) → PSNR of video with loss

PSNR of video with loss → PSNR profit calculator
Partition Loss and Effect

Frame corruption

Corruption propagation
PSNR of Loss-Free Video

![Graph showing PSNR over frame number](attachment:image.png)
PSNR of Videos

![Graph showing PSNR of videos with and without loss](image)

- **Loss free video**
- **Video with loss**

Frame number

PSNR
PSNR Profit of Video Partition

- Loss free video
- Video with loss
- PSNR profit

Frame number

PSNR

i

i+m
Example of PSNR Profit of One Partition
Example of PSNR Profit of One Partition
Example of PSNR Profit of One Partition
Example of PSNR Profit of One Partition
Example of PSNR Profit of One Partition

0 0 9 7 7 6 5 4 = 38
Average PSNR Profit per Frame

<table>
<thead>
<tr>
<th>Partition</th>
<th>Key (IDR) Frame</th>
<th>Predicted Frame</th>
<th>Bi-predicted Frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partition A</td>
<td>1890</td>
<td>473</td>
<td>9</td>
</tr>
<tr>
<td>Partition B</td>
<td>509</td>
<td>266</td>
<td>4</td>
</tr>
<tr>
<td>Partition C</td>
<td>179</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Total Profits:
- Partition A: 2399
- Partition B: 918
- Partition C: 14
Video Caching at Proxies Close to Clients
H.264 Partitioned Data Caching

Profit

1890 509 9 4 1 473 266 179 9 4 1 473 266 179 9 4 1 473 266
H.264 Partitioned Data Caching

Profit

<table>
<thead>
<tr>
<th>Size (Bytes)</th>
<th>Partitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1890 509 9 4 1 473 266 179 9 4 1 473 266 179 9 4 1 473 266</td>
<td></td>
</tr>
</tbody>
</table>

Server Capacity
Number of Partitions Stored

![Graph showing the number of partitions stored against the number of videos in the system.](image)
Server and Client Profits

![Graph showing server and client profits over the number of videos in the system.](image)
Profit in Lossy Environment
Conclusions

• **A profit model** is established to measure the contribution of each video partition to the quality of video replay.

• **Optimal caching** based on the profit model can significantly improve the utilization of cache space and the quality perceived by clients.
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Thank You