A Joint Online Transcoding and Delivery Approach for Dynamic Adaptive Streaming

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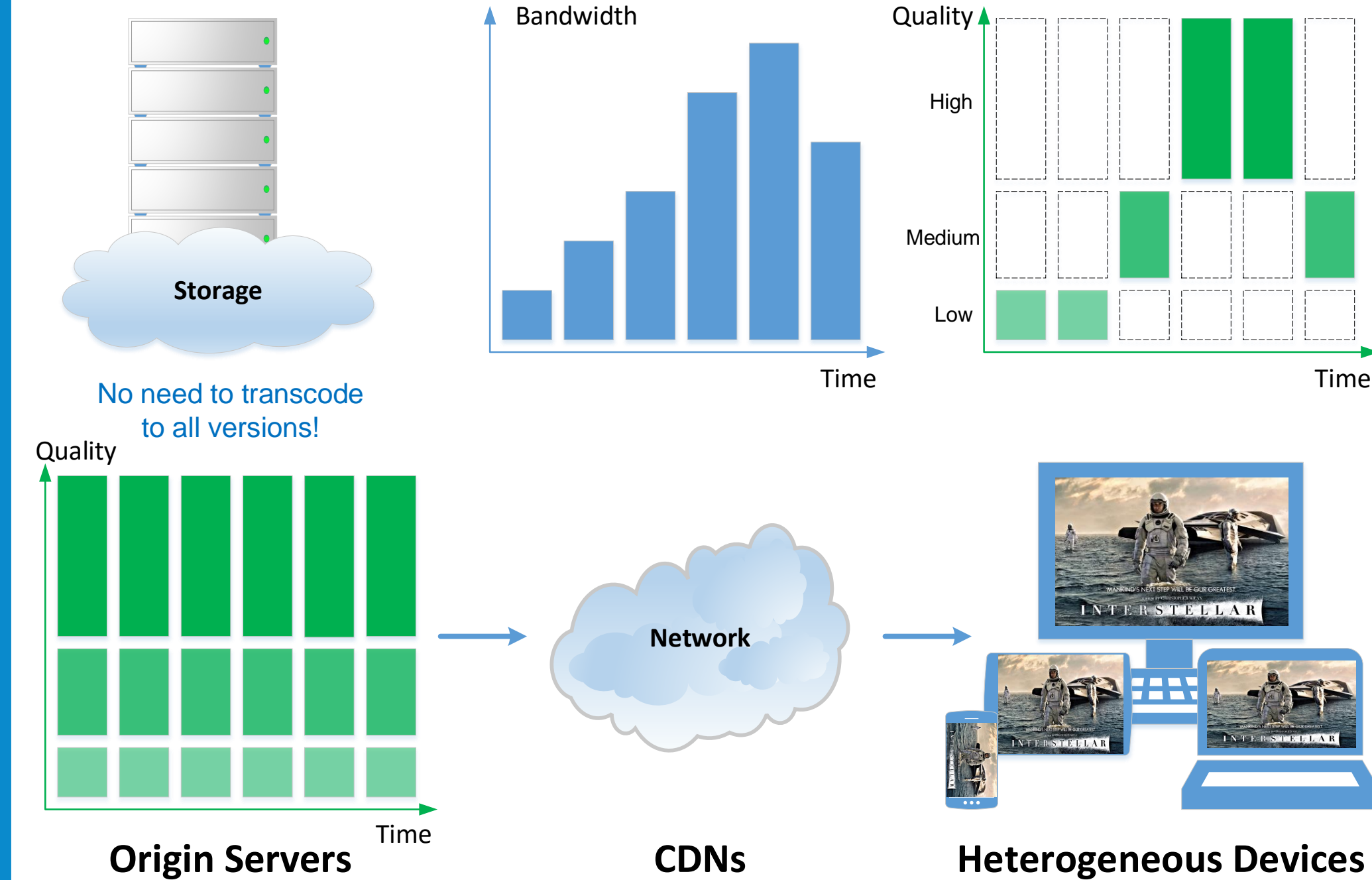THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

BACKGROUND

Popular online video sites

transcode their vidoes to multiple versions

$$\rightarrow \{ mp4, [H.264, AAC] \} \begin{cases} version_1 & (x_1\ kbps) \\ version_2 & (x_2\ kbps) \\ \vdots & \vdots \\ version_n & (x_n\ kbps) \end{cases}$$

and then stream them through the network,

so that users can enjoy a better watching experience according to their current bandwidths and device decoding abilities.

PROBLEM

They all transcode origin videos to all versions. In such scheme,

- only a small set of candidate bitrates to manually choose from; cannot effectively adapt to the changing network conditions

- huge computing resource consumption
  - H.264: 1/3 to 2/3 of playback time
  - H.265: 30+ times of playback time
  - 1 CPU: 1-2 concurrent coding tasks

- oblivious of users' *preferences* of different *peering servers*

OBSERVATIONS & INSIGHTS

Video Viewing Patterns (Pro. & UGC)
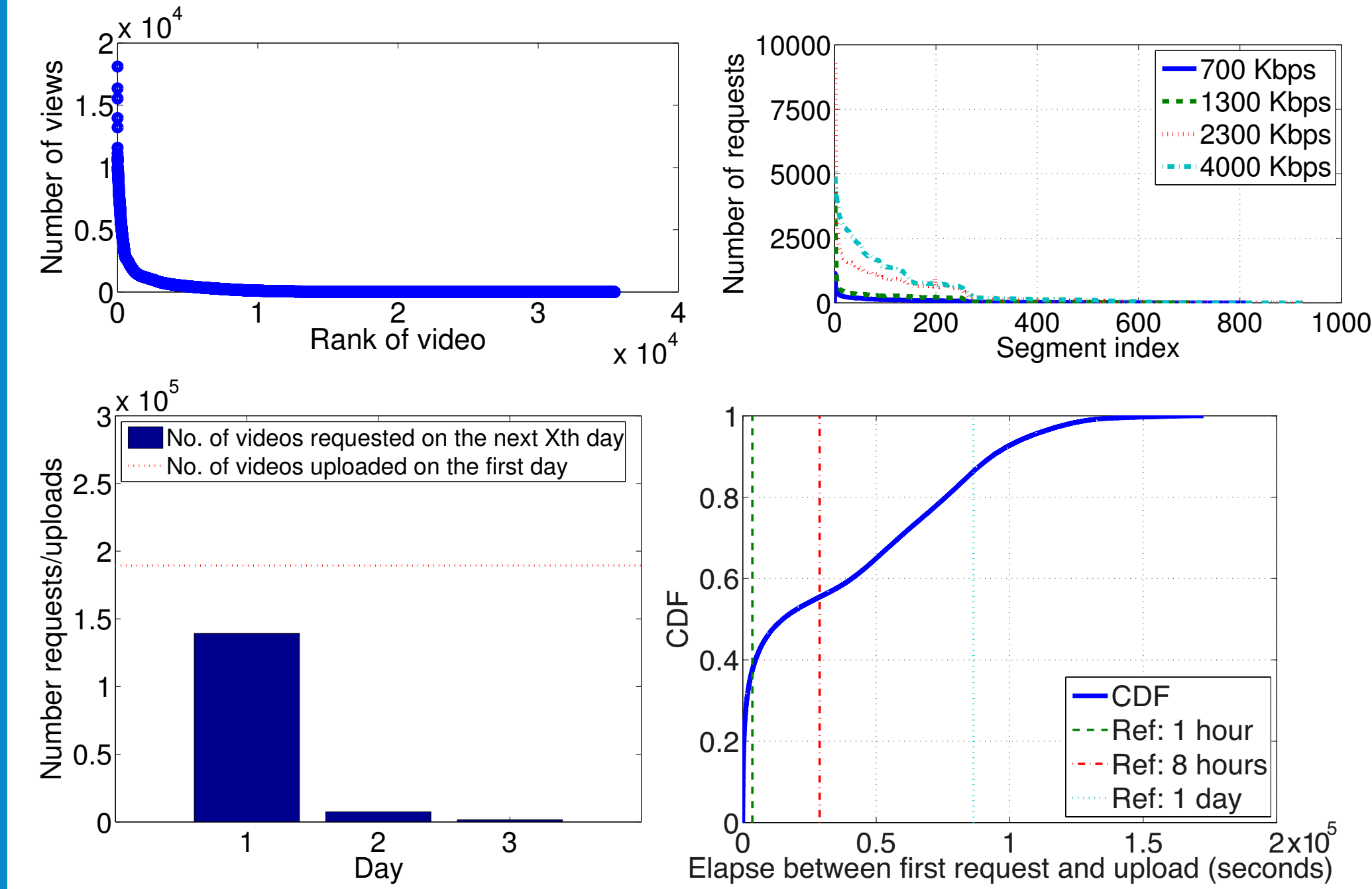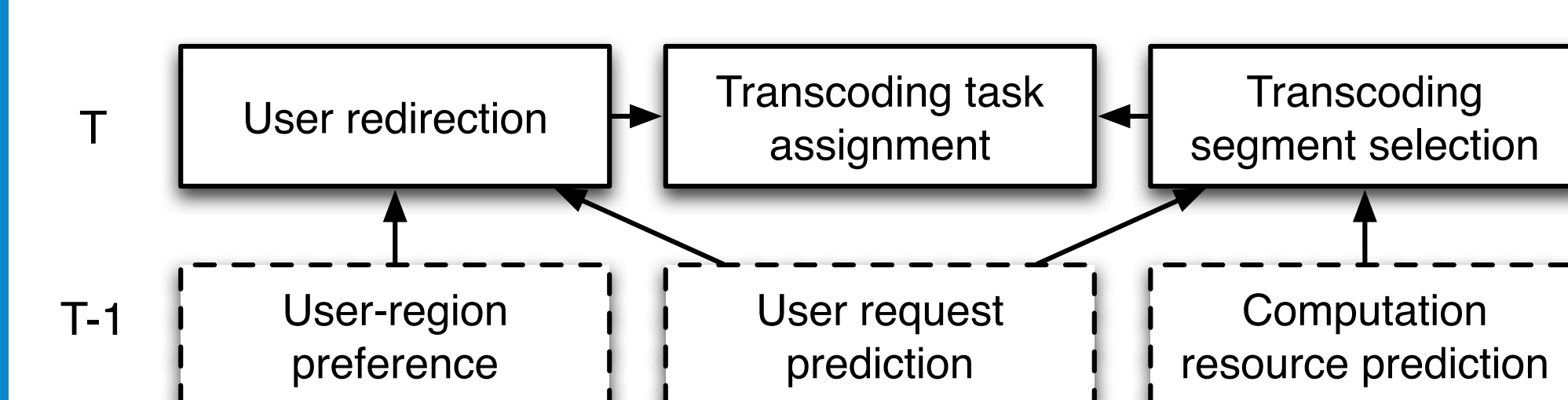

CDN Patterns (CPU load & bandwidth)
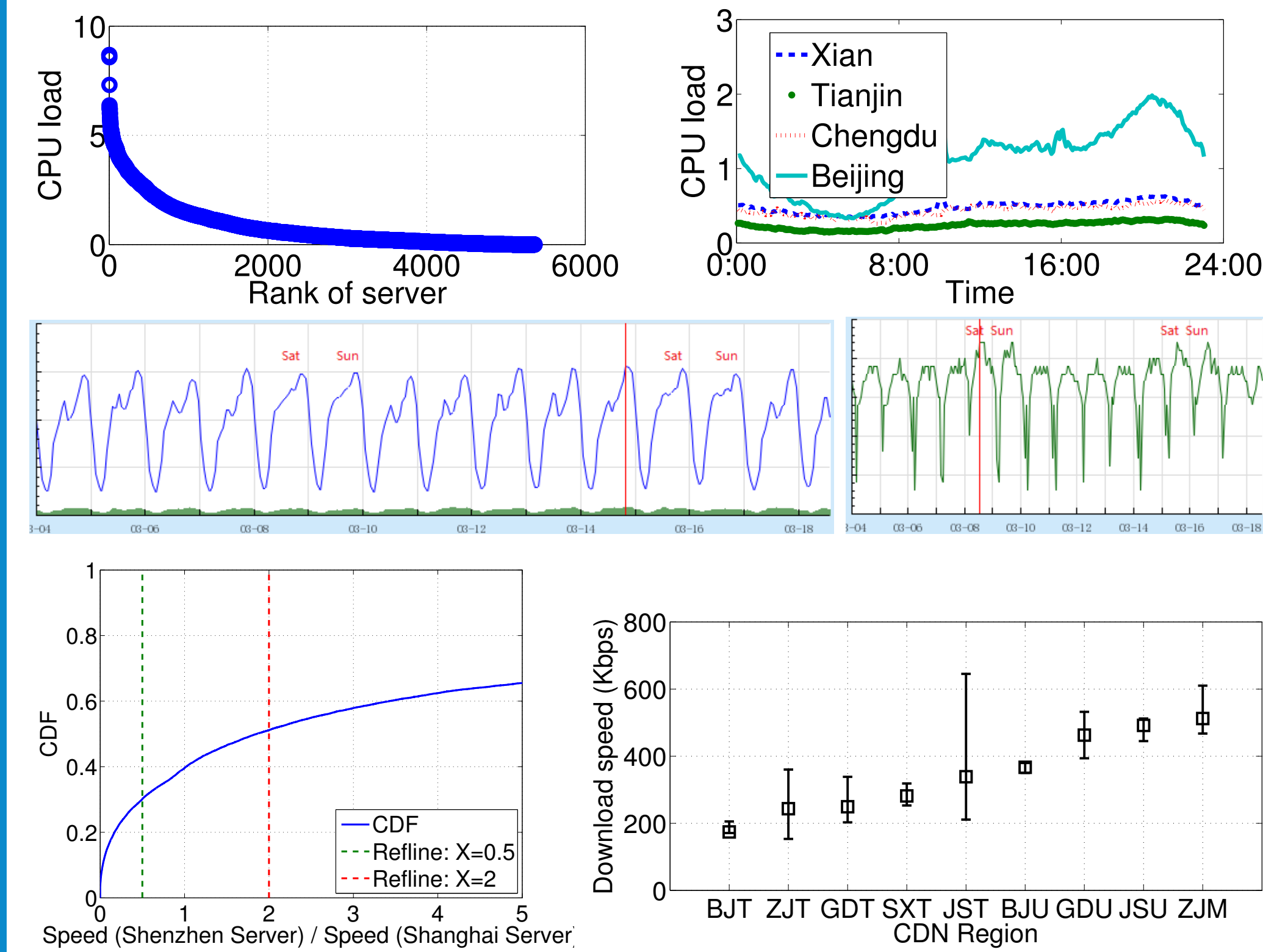
Insights:
- ⋆§ No necessary to pre-transcode/store all
- ⋆§ Most backend servers in CDNs are predictably(stably) idle
    Can be scheduled for transcoding?
- ⋆§ users have preferences in CDN regions
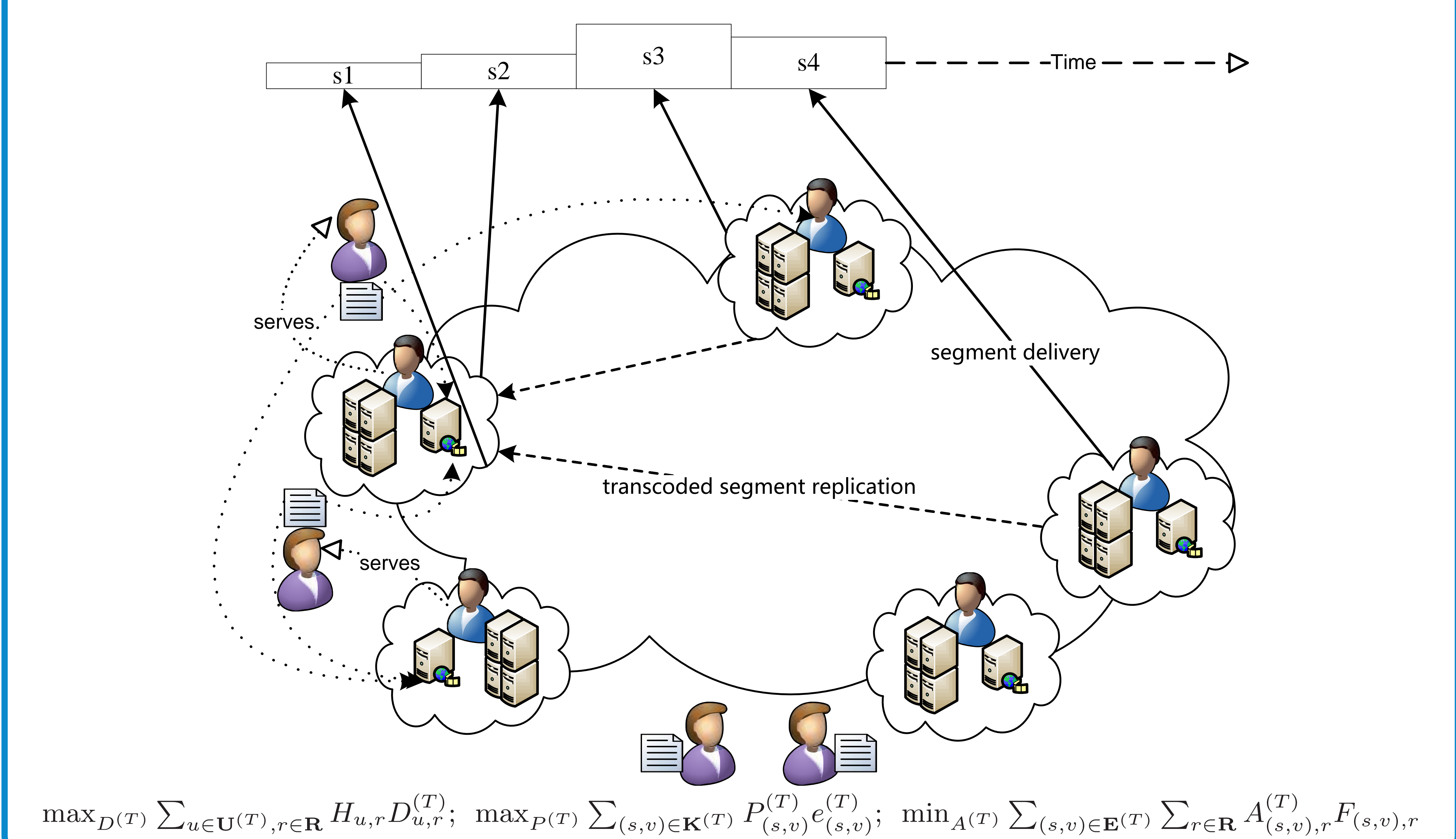- ⋆§ regions have preferences in media versions
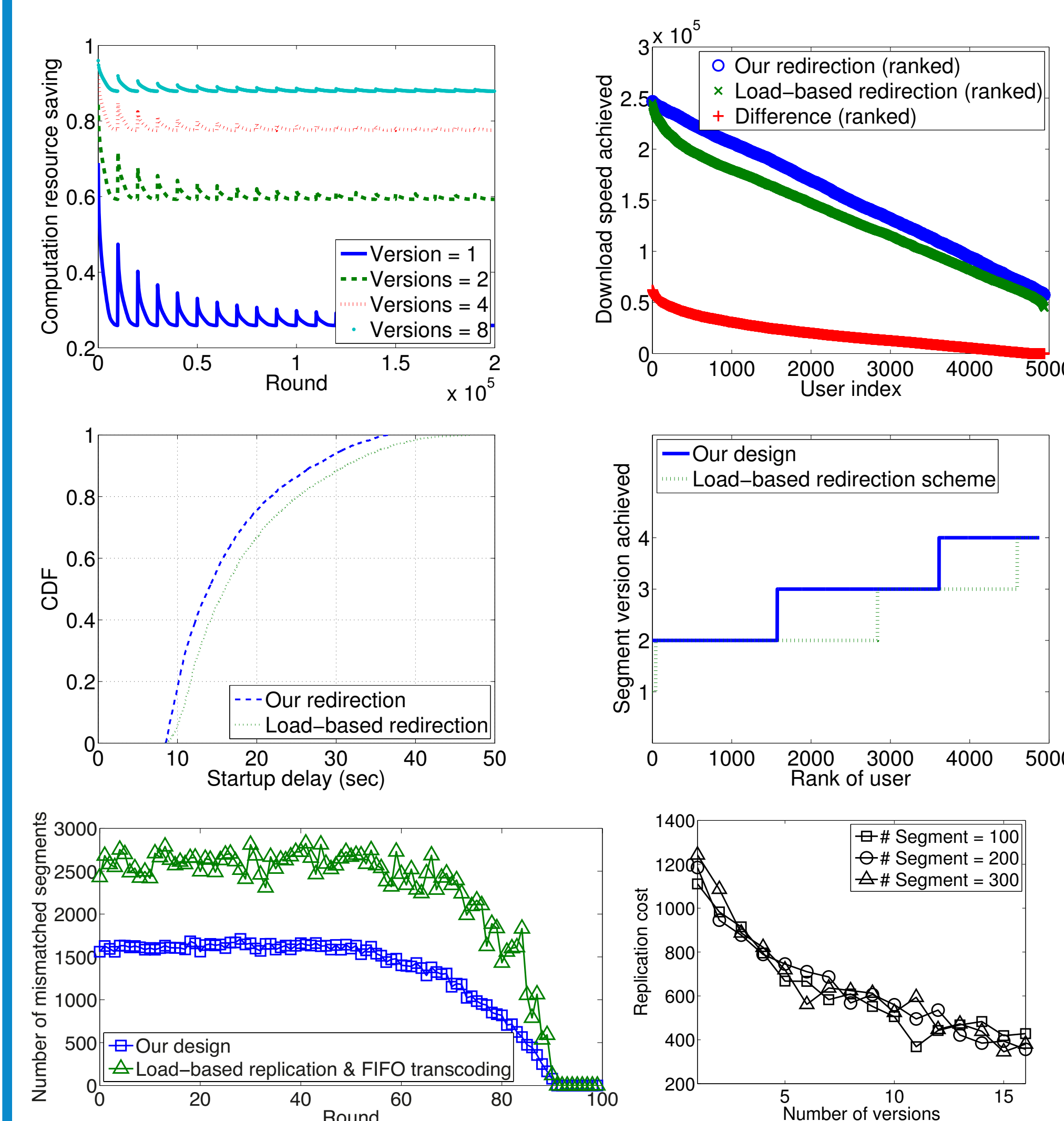
FRAMEWORK

3 phases joint optimization

METHODS

Girls Chasing *Boys*! (Stable Maching plus Linear Programming)

$$\max_{D^{(T)}} \sum_{u \in \mathbf{U}^{(T)}, r \in \mathbf{R}} H_{u,r} D_{u,r}^{(T)}; \quad \max_{P^{(T)}} \sum_{(s,v) \in \mathbf{K}^{(T)}} P_{(s,v)}^{(T)} e_{(s,v)}^{(T)}; \quad \min_{A^{(T)}} \sum_{(s,v) \in \mathbf{E}^{(T)}} \sum_{r \in \mathbf{R}} A_{(s,v),r}^{(T)} F_{(s,v),r}$$

RESULS

HIGHTLIGHTS

- 44.8% users enjoy higher bitrate versions than the load-balanced redirection scheme

- 4.5x users enjoy the highest possible bitrate

- Mismatch rate reduced by over 42.2%

- ∼ 80% computing resource saved when the number of versions is 4.
  The higher the number is, the more resource our approach saves.

AFTERWORD

Transcoding and delivery can, and should be considered & done jointly.
§ A joint work with THU, HKU, Tencent.
§ Appeared in IEEE TMM 2015.
§ In serving WeChat video clip, QZone video...