SocialTube: P2P-assisted Video Sharing in Online Social Networks

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Outline

- Introduction
- Facebook measurement and analysis
- The design of socialtube
- Performance evaluation
- Conclusion
Introduction

- Video sharing has been an increasingly popular application in Online Social Networks (OSNs) (e.g., Facebook [1], Twitter [2]).

- According to comScore Releases in August 2010, Facebook is now the second-largest online video viewing platform.
Introduction

- However, OSN’s further advancement is severely hindered by the intrinsic limits of the conventional client/server architecture of its video sharing system,

- which is not only costly in terms of server storage and bandwidth but also not scalable with the soaring number of users and video content in OSNs.
Introduction

- SocialTube has a social network (SN)-based P2P overlay construction algorithm that clusters peers based on their social relationships and interests.

- SocialTube also incorporates an SN based video prefetching algorithm to increase the video prefetching accuracy to minimize video playback startup delay.
Facebook measurement and analysis

- They used breadth-first-search [13] to crawl data from over 1,000,000 users seeded by 5 users in the USA.

- The collected dataset includes information about user friendship relations, interests, location, and videos uploaded and shared by users.

- For each video, we retrieve its title, length, and viewers when available.
A. Effect of Social Distance on Video Viewing Patterns.

O1: At first, we investigate the impact of social distance on user video viewing patterns.

Among 52,500 video watching activities involving 12,000 users, they measured the social distance of a video viewer from the video owner, and show the distribution in Figure 1.
Facebook measurement and analysis

Fig. 1: Social distance.

Fig. 2: Different viewer types.
Facebook measurement and analysis

- From O1, we obtain the inference (I):

- I1: A video viewer group of a video owner in Facebook is mostly within the 2-hop friend circle of the owner.

- Note that a user may own more than one video.
Facebook measurement and analysis

- O2: On average, in a user’s viewer group, 25% of viewers watched all, 33% of viewers watched 80%, and all viewers watched 20% of the user’s videos.

- They use a threshold $T_h$ for the percent of all the videos of a user that a viewer watches in order to become a follower, and set $T_h=80\%$ in this analysis.
Facebook measurement and analysis

Fig. 3: Social distance between follower and video owners.

Fig. 4: Social distance between non-follower and video owners.
Facebook measurement and analysis

- O3: Viewers that watch almost all of a user’s videos (i.e., followers) usually are 1-hop friends of the user, while most of other viewers (i.e., non-followers) are 1-hop or 2-hop friends of the user.

- **Authors** select a sample of 118 distinct users that watched more than one video from our dataset and manually classify the videos they watched into 19 interest groups based on video content.
Facebook measurement and analysis

Fig. 5: Interest clustering effect

Fig. 6: Video source in Facebook.
Facebook measurement and analysis

- **B. Effect of Interest on Video Viewing Pattern**

- **O4**: Users tend to watch the videos of their interests and each user generally has ≤ 4 video interests.

- A user can post on Facebook either self-uploaded videos or external video links from a third party video service provider such as YouTube.
Facebook measurement and analysis

- O5: A large percentage of videos in Facebook are from YouTube, where the user video viewing patterns are driven by interests.
Facebook measurement and analysis

- Combining O1-O5, we can find that different watching incentives can be applied to different types of viewers.

- The followers of a user watch most of the user’s videos regardless of the video content because of their close social relationship (e.g., close friends and fervent admirers).

- I2: Followers are primarily driven by social relationship to watch videos, while non-followers are driven mainly by interest.
In this paper, we use server to represent all video source servers, including both Facebook and external video servers.

Similar to current peer assisted content delivery mechanisms, the peers in SocialTube store videos they have watched for video redistribution.
The design of Socialtube

- In SocialTube, a video is divided into small chunks with a fixed size.

- Thus, a watching user only needs to download the corresponding chunks of the video segment to watch.
The design of Socialtube

- A. Social Network based P2P Overlay Construction Algorithm

- To identify followers and non-followers of a source node for structure construction, SocialTube pre-defines two thresholds, $T_h$ and $T_l$, for the percent of videos in the source node that a viewer has watched during a time unit, say one week.
The design of SocialTube

- If the percent value of a viewer is $\geq T_h$, the viewer is a follower.

- If the percent is $T_l < x < T_h$, the viewer is a non-follower.
The design of Socialtube

Fig. 7: Structure of SocialTube.
The design of Socialtube

- **B. Social Network based Prefetching Algorithm**

  - To reduce the video startup latency, we propose a push-based video prefetching mechanism in SocialTube.

  - In SocialTube, when a source node uploads a new video to the server, it also pushes the prefix (i.e. first chunk) of the video to its followers and to the interest-cluster-peers in the interest clusters matching the content of the video.
The design of Socialtube

- The prefix receivers store the prefix in their cache.

- Those interest-cluster-peers and followers who are not online when the source node pushes the prefix will automatically receive it from the source node or the server once they come online.

- After the source node leaves, the responsibility to push the prefix falls to the server.
The design of SocialTube

- Similar to BitTorrent, SocialTube allows a requester to request 4 online nodes at the same time to provide the video content in order to guarantee provider availability and achieve low delay by retrieving chunks in parallel.

- It first contacts interest-cluster-peers, then followers, then the source node.

- If the requester still cannot find 4 providers after the source node is contacted, it resorts to the server as the only provider.
Performance evaluation

Fig. 8: Prefetching accuracy vs. node population.

Fig. 9: Prefetching accuracy vs. # of prefetched videos.
Performance evaluation

Fig. 10: Prefetching accuracy vs. # of watched videos.

Fig. 11: Percent of server contribution vs. client population.
Conclusion