Chapter 13
Cooperation Among Members of Online Communities: Profitable Mechanisms to Better Distribute Near–Real–Time Services

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ABSTRACT
Today some of the most popular and successful applications over the Internet are based on Peer-to-Peer (P2P) solutions. Online Social Networks (OSN) represent a stunning phenomenon too, involving communities of unprecedented size, whose members organize their relationships on the basis of social or professional friendship. This work deals with a P2P video streaming platform and focuses on the performance improvements that can be granted to those P2P nodes that are also members of a social network. The underpinning idea is that OSN friends (and friends of friends) might be more willing to help their mates than complete strangers in fetching the desired content within the P2P overlay. Hence, an approach is devised to guarantee that P2P users belonging to an OSN are guaranteed a better service when critical conditions build up, i.e., when bandwidth availability is scarce. Different help strategies are proposed, and their improvements are numerically assessed, showing that the help of direct friends, two-hops away friends and, in the limit, of the entire OSN community brings in considerable advantages. The obtained results demonstrate that the amount of delivered video increases and the delay notably decreases, for those privileged peers that leverage their OSN membership within the P2P overlay.

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1. INTRODUCTION

Online Social Networks and P2P are both tools contributing to the way people are using and approaching the Internet today. The first pursues the target to bring, inside the network, social relationships like friendship or professional acquaintances that constitute a significant fraction of our everyday life. In this manner people, regardless of being close or far away, may stay in touch and keep alive their social connections. The second, instead, aims at effectively providing networked services -- such as file distribution, video streaming -- via resource sharing, where resource means bandwidth, processing power, memory of the network users.

Although OSN and P2P were born and have evolved independently, only very recently a few proposals have arisen in academia, that aim at merging some of their features, taking advantage of the strengths of both. Indeed, if P2P allows to better spread contents, reducing the server stress, OSNs can, e.g., greatly ease the search for content, taking advantage of the similarities in the personal taste of connected users. TRIBLER, the social-based P2P system proposed by Pouwelse et al. (2006), uses the OSN relationships as the base layer of a P2P system, not only for content discovery or recommendation, but also to improve download performance. The improvement is achieved thanks to the cooperative downloading implemented by the users that join the same OSN groups, where members who trust each other cooperate. Along a parallel path, Graffi, Gross, Stingl, Hartung, Kovacevic, and Steinmetz (2011) suggest that OSNs will be the next main application field for the P2P paradigm: through their prototype, the authors show that a P2P-based online social network is feasible and testify that the distributed approach is indeed profitable.

Other works have recently provided interesting contributions on the mobile side of P2P services: Kubo, Shinkuma, and Takahashi (2010) consider how effective a social networking service is as a platform for mobile P2P multicast; Qureshi, Min, and Kouvelatos (2010) lie a framework to identify trustworthy users and to allow secure transmissions, while isolating untrustworthy nodes from the mobile community of a social network.

However, most of the previous works focus on P2P for file-sharing and there is little work that merges the OSN friendship concept with P2P streaming. The concise contribution of Abboud, Zinner, Lidanski, Pussep, and Steinmetz (2010) indicating how social networks can be used to build new incentive mechanisms, represents a first attempt in this direction. Our work develops a similar idea: we aim at incorporating in a P2P streaming architecture the notion of social relationships, assuming these are preferential links to retrieve content. The delivery mechanisms we devise aim at favoring OSN peers whenever the P2P overlay operates in a critical regime, i.e., when the overall bandwidth is scarce. In such circumstance, an OSN peer requesting video contents and not finding any, asks for the help of direct friends that discard non-OSN peers currently served to make room for their mate. Several variants to this priority concept implemented in favor of OSN friends are examined. Priority is extended to friends of friends, a choice motivated by the observation that mutual friendship is a strong bond that can lead to personal information sharing, as shown in Nagle and Singh (2009) and Acquisiti and Gross (2005, 2006). The strategy where priority is granted to all other OSN members, regardless of direct friendship, is also investigated as the limit case.

To validate our proposal, the first step we have taken has been to spot in literature (and properly correct) the graph model of a popular social network for picture and video sharing, Flickr (http://www.flickr.com/). Next, we have implemented and developed a simulative tool that evaluates the performance achieved by the proposed delivery strategies. Both the amount of delivered video and