Access Control and Resource Allocation for Peer-to-Peer Video Streaming Based on Fuzzy Logic

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Abstract. The fast development of peer-to-peer video-on-demand (P2P-VoD) technologies provides people new experience of watching videos and live TVs online. However, reliability of the streaming source and resource allocation are still concerns from end-users. This paper introduces an adaptive control framework using fuzzy logic into user preference definition for peer-to-peer (P2P) video streaming access control, and designs a novel decision-making mechanism using formal fuzzy rules and reasoning mechanisms to adjust P2P video streaming resource allocation following individual users’ preferences.

1 Introduction

With a fast development of P2P technology, various applications based on P2P have enriched people’s daily lives. P2P-VoD such as PPLive, PPStream and TVAnt are among the most popular applications. The system described in [1] has been proved that it can offer users a fast, convenient and on-demand video streaming experience. However, as illustrated in [2], users may suffer attacks from other peers when they are enjoying videos. Thus, the reliability of video streaming sources becomes one of the biggest issues in P2P-VoD. Like other P2P applications, how to allocate video streaming resources is another issue. In this paper, the trustworthiness of people in online social network is applied into a P2P-VoD system to ensure the reliability of video streaming sources, since the trustworthiness between people in online social networks are widely used and adopted by people. As described in [3], the relationships between users in online social networks are more complex than a simple indication of two people’s mutual acquaintance, and this complexity may cause confusion when users have to determine trust degrees between each other. Users also may remain uncertain when allocating resources to

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peer users, since the capacity of a transmission channel, the reliability of that channel, and local or remote resources may vary. To manage a collection of uncertain factors in the decision-making process for access control and resource allocation in P2P video streaming, we provide an adaptive mechanism using users’ own preferences represented in decision-making policies. We introduce “fuzziness” into policy representation and enforcement in this mechanism. Applying fuzzy logic into policy-based access control and resource allocation for P2P video streaming can help users handle multiple factors in decision-making activities with a certain level of uncertainty. We propose and implement a P2P video streaming system over online social networks using policy-based access control and resource allocation, which combines various types of control information following users own preferences based on fuzzy enforcement of policies containing uncertain factors.

2 Access Control and Resource Allocation

Since we simulate the trust in P2P video streaming by using trust relationships from online social networks, we need to understand trust in online social networks first. Some online social networks allow users assigning trust levels for friends and other users [5]. Golbeck and Hendler propose a binary method to calculate the trust between users in online social networks [3]. Other methods such as the ones described in [6] also provide algorithmic supports for calculating trust between users. But in most online social networks, trust between users is simply calculated from the level of friend-of-a-friend (FOAF) relationships. In this paper, we also calculate trust between people from the level of FOAF relationships.

Following the categorization described by Beth et al. [4], we categorize trust into two classes - direct trust and indirect trust. A trust relationship formed from direct experience or negotiations can be characterized as direct trust; a trust relationship or a potential one built from recommendations by a trusted third party or a chain of trusted parties, which create a trust path, is called indirect trust. Based on FOAF relationships, trust between people can also be classified into direct and indirect trust. As discussed before, indirect trust relationships may form from different paths, and the degree of each path may vary. So users cannot always clearly tell the trustworthiness between people in online social networks, because everyone has his or her own opinion on trust, and he or she may remain uncertain when defining trust between users in online social networks. We introduce fuzzy logic into the definition of trustworthiness into our framework, and provide a binary access control decision for P2P video streaming based on the degree of trustworthiness between peer users.

Users may feel the confusion when allocating resources for P2P video streaming since multiple factors need to be considered. For instance, the actual bandwidth for P2P video streaming between peer users may be impacted by the communication channel’s capacity, the communication channel’s reliability, and access point control. The channel capacity determines the information transmission speed; the channel reliability determines the integrity and safety of transferred information; access point control determines the trustworthiness of peer users and their access privileges. So we also use fuzzy logic in our resource