Credible Reputation Metric for P2P e-Communities

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1. Introduction

Peer-to-Peer (P2P) systems and applications are attracting a lot of attention nowadays, as they mimic human communities and support useful community. Due to their social and decentralized nature, trust plays an essential role for their functionality. P2P reputation systems have emerged in order to satisfy this need for trust. However, reputation systems themselves are targets of multiple kinds of attacks which should be taken into consideration during the design of the former in order to be effective.

In this paper[1] we propose a reputation mechanism for P2P e-communities of entities which offer services to each other. The focus is on the reputation inference algorithm (reputation metric) which integrates various credibility factors.

2. P2P Reputation Systems Credibility Requirements

A P2P reputation system comprises entities that play interchangeably the roles of *trustor*, *trustee* and *recommender*. The *trustor* is an entity which wants to make a *trust decision* regarding whether to participate or not in a *transaction* with another entity, the *trustee*. The *recommender* is the entity that provides the trustor with a *recommendation*, that is information regarding the trustworthiness of the trustee. To make a trust decision the trustor tries to predict the future behaviour of the trustee by estimating the trustee's *reputation* based on to its own earlier experience with the trustee and / or by acquiring *recommendations* from other entities. A recommendation is either a *rating* for a single transaction, or an *opinion* formed by the outcome of several transactions.

Entities participating in reputation systems can distort the credibility of the latter in various ways, such as by giving **unfair recommendations** either deliberately (*bad mouthing*) [1] or not and by **changing their behaviour strategically** (*oscillating behaviour*) [2]. In order to mitigate these attacks we considered the following requirements, which have been pointed out in [3]: 1. The *formation of opinion-based recommendations* should take into consideration the number of the aggregated recommendations and their recency. The *confidence* that the recommender has for its recommendation should also be estimated and provided to the trustor. 2. *Credibility of recommender* should be tracked. 3.The algorithm used for *reputation calculation* should take into account both direct and indirect transactional information, as well as the recency of recommendations and the confidence that can be placed on recommendations and on direct experience.

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3. Reputation Inference Formulae and Simulation Results

$$DirectRep_{A,B} = \frac{1}{\sum_{n} e^{-Dt}} \sum_{i=1}^{n} e^{-Dt} TransEval_{t_i,B}$$

$$IndirectRep_{A,B} = \sum_{\rho=1}^{k} \frac{RecRep_{\rho} * (RecommendationValue_{\rho,B} * Conf_{\rho,B})}{k}$$

$$OverallRep_{A,B} = \alpha * Conf_{A,B} * DirectRep_{A,B} + (1-\alpha) * IndirectRep_{A,B}$$

$$Conf_{A,B} = NT * (1 - Dev_{A,B}) * e^{-Dt}$$

$$NT = \begin{cases} 1, & if\ n \geq N \\ \frac{n}{N}, & otherwise \end{cases}$$

$$Dev_{A,B} = \sum_{i=1}^{n} \frac{\left| TransEval_{t_i,B} - DirectRep_{A,B} \right|}{n}$$

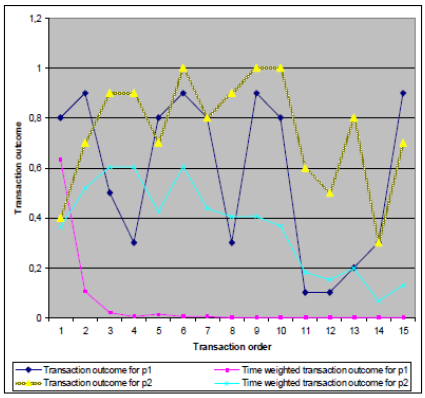

Figure1. Time Weighting of Transaction Outcome Values for p1 and p2

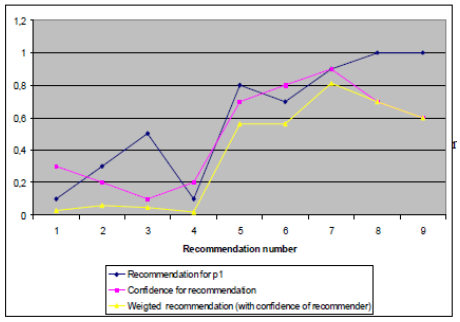

Figure 2. Weighting Recom. Values with Confidence of Recommender

4. Conclusions

We propose a reputation metric which integrates various sources of information by assigning weights that express their importance. By incorporating confidence and the time decay function, we aim at dealing with *strategic changes of transactional behaviour*. Keeping track of recommendation reputation helps against *bad mouthing* attacks. Our reputation metric is dynamic because of the time considerations on one hand and the possibility to use different weights for direct and indirect reputation.

References

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