A Stochastic Model for Reputation Management in Introduction-Based Trust Systems[1,2]

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A growing portion of daily Internet commerce incentivises parties involved in any particular transaction to rate one another, so that ratings of a given party in previous transactions can be leveraged to decide whether or not to transact with that party in the future. Well-known examples include the feedback forum on the auction website "Ebay," the user-based moderation system on the discussion forum "Slashdot" and the partly crowdsourced website rating tool within the browser plug-in "Web-of-Trust." While these systems may aggregate ratings and transform them into reputations differently [2], they share an intent to use the reputation-based signaling of trustworthiness for discouraging interactions with nodes that repeatedly misbehave and, in the long run, have a positive effect on the service's quality for the behaving nodes.

In peer-to-peer networks for which a central reputation authority becomes infeasible, a recently proposed scheme (described in [1] in the context of secure Internet packet routing) is a so-called introduction-based approach. Fundamental to such an approach is that transactions are allowed only between two parties that are *connected*, where both parties consent to the connection through an introduction sequence involving a third party. In other words, there are three parties involved in every introduction sequence: the *requester* is the node who initiates the sequence, the *target* is the node to which the requester wishes to be introduced and the *introducer* is the node connected to both requester and target who is asked to make the introduction. The introducer may or may not offer the introduction and the target may or may not accept the introduction, but if offered and accepted then the connection between requester and target is established and the two nodes can transact and/or request introductions to others. The connection exists indefinitely until the sender or target elects to close it, and both parties provide feedback to the introducer through the lifetime of the connection. Note that, depending on the state of all nodes' connections, forming a new connection may require multiple consecutive introductions; moreover, it is also assumed that the network initializes with every node having at least one a-priori connection in place.

The described introduction-based trust system assumes a constructive interplay among several different decision processes within the different roles e.g., whether a sender or target closes a connection, whether a target accepts an offered introduction, whether an introducer offers a requested introduction, how feedback is generated by sender/target as well as interpreted by the introducer. We address this challenge through the formulation and analysis of a particular stochastic network model, where the hidden (binary) state of every node is either well-behaved or mis-behaved and that node's (real-valued) reputation is equated to the log-likelihood that the node is well-behaved given the transactions observed on all connections. Our analysis to date has well-characterized the decision processes of requesters and targets in terms of nodes' reputations: for example, a node's decision to close a connection and a target's decision to decline an offered introduction are shown to be minor variations of the celebrated Sequential-Probability-Ratio-Test solution to the famous Wald problem [4]; the coupling of reputations across all connections is shown to amount to a standard inference computation on a tree-structured Bayesian network [3]. The decision processes associated with introducers (and providing feedback to introducers) remains under investigation.

References

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