

# Chapter V

## Towards Semantic-Based P2P Reputation Systems

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### ABSTRACT

*Peer-to-peer (P2P) systems represent nowadays a large portion of Internet traffic, and are fundamental data sources. In a pure P2P system, since no peer has the power or responsibility to monitor and restrain others behaviours, there is no method to verify the trustworthiness of shared resources, and malicious peers can spread untrustworthy data objects to the system. Furthermore, data descriptions are often simple features directly connected to data or annotations based on heterogeneous schemas, a fact that makes difficult to obtain a single coherent trust value on a resource. This chapter describes techniques where the combination of Semantic Web and peer-to-peer technologies is used for expressing the knowledge shared by peers in a well-defined and formal way. Finally, dealing with Semantic-based P2P networks, the chapter suggests a research effort in this direction, where the association between cluster-based overlay networks and reputation systems based on numerical approaches seems to be promising.*

### INTRODUCTION

Nowadays P2P (Peer-to-Peer) systems represent a large portion of Internet traffic, and are fundamental data sources. They are characterized by their heterogeneity and their dynamic and autonomic

nature. In essence, a P2P system is viewed as a distributed network system composed of participants (peers) with similar resource capabilities. In a pure P2P system, since no peer has the power or responsibility to monitor and restrain the others behaviours, there is no method to verify the

trustworthiness of shared resources, and malicious peers can spread untrustworthy data objects to the system. Furthermore, data descriptions are often simple features directly connected to data or annotations based on heterogeneous schemas, a fact that makes difficult to obtain a single coherent trust value on a resource. The combination of Semantic Web and peer-to-peer technologies can be used for expressing the knowledge shared by peers in a well-defined and formal way: metadata are absolutely crucial in order to describe the resources managed by the peers. Moreover, Semantic-based peer-to-peer networks have a number of important advantages over previous simpler peer-to-peer networks. Over the years, efforts have been done to refine topologies of P2P networks, modern routing protocols like Chord (Stoica et al., 2001), CAN (Ratnasamy et al., 2001) are based on the idea of (DHT) (Distributed Hash Tables) for efficient query routing, but they not address more complex metadata sets. Only in the last few years, the Semantic-based networks --the Edutella project (Nejdl et al., 2003)--combines Semantic Web and peer-to-peer technologies in order to make distributed learning repositories possible and useful. In this chapter, we provide a brief overview of trust research field and reputation systems and we investigate in particular P2P-based ones. We describe their evolution over the years, their different topologies, and the advantages of using metadata connected to resources and Semantic-based networks in order to build Semantic-based P2P reputation systems.

## TRUST AND REPUTATION SYSTEMS: AN OVERVIEW

The increasingly electronic commerce transactions, Web-based access to information, interpersonal interactions via electronic means, have led to a growing interest and study about trustworthiness of these services, since it is often hard to assess the trustworthiness of remote entities. In particu-

lar what is difficult is to collect evidence about unknown transaction partners, and that makes it hard to distinguish between high and low quality service providers in a computer network.

Trust is not a new research topic in computer science, and depending on the area where the concept of trust is used--security and access control in computer networks, reliability in distributed systems, game theory and agent systems, and policies for decision making under uncertainty--it varies in these different communities in how it is represented, computed, and used.

In this section, according in particular to (Jösang, Ismail, & Boyd, 2007) (Artz & Gil, 2007) (Ramchurn, Huynh, & Jennings, 2004) (Grandison & Sloman, 2000) we will give an overview of trust research in computer science, describing how different areas define and use trust in a variety of contexts. The various definitions of trust will be reviewed and classified, with particular reference to collaborative sanctioning systems, known as *reputation systems*.

## Reasoning about Trust

*Trust* is a complex subject related to belief in the honesty, truthfulness, competence, reliability, and so forth, of the trusted person or service. There is no general consensus in the literature on what trust is and on what constitutes trust management, because the term trust is being used with a variety of meanings (McKnight & Chervany, 1996), but many have recognized the value of modeling and reasoning about trust computationally. In (Jösang et al., 2007) two definitions of trust are introduced: *reliability trust* and *decision trust*, respectively. The first one is introduced by means of the Gambetta definition of trust (Gambetta, 1988) as “the subjective probability by which an individual, *A*, expects that another individual, *B*, performs a given action on which its welfare depends.” This definition includes the concept of *dependence* on the trusted party, and the *reliability* (probability) of the trusted party as seen by the trusting party.

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