

Chapter 12

Trust Management and Modeling Techniques in Wireless Communications

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ABSTRACT

Trust management is an emerging technology to facilitate secure interactions between two communicating entities in distributed environments where the traditional security mechanisms are insufficient due to incomplete knowledge about the remote entities. With the development of ubiquitous computing and smart embedded systems, new challenges and threats come up in a heterogeneous environment. Trust management techniques that depend on a centralized server are not feasible in wireless peer-to-peer communication networks. Hence, the trust management and modeling strategies are becoming increasingly complex to cope with the system vulnerabilities in a distributed environment. The aim of this chapter is to have a thorough understanding of the trust formation process and the statistical techniques that are used at different stages of the trust computation process. The functional components of a trust management framework are identified and some of the existing statistical techniques used in different phases of the trust management framework are analyzed.

INTRODUCTION

In the recent years, trust is a topic of importance in many disciplines like computer science, wireless communications and Cognitive Sciences. Trust is defined as the belief over another person that he will behave according to an established pattern of rules. The multiagent system researchers introduced the concept of trust in computer science. These intelligent agents interact with each other and try to emulate the trust observed in human societies. Hence, trust has become an integral part of human lives and it was found to be an effective security mechanism for open environments like Internet. Considerable research has been done on modeling and managing trust and reputation in distributed systems

The definition of social trust was given by Diego Gambetta where trust is a particular level of subjective probability with which an agent will perform a particular action, independently of whether he is monitored or not. The notion of trust and reputation systems originate from the study of social sciences where the dynamics of trust in human societies are studied (Yu, Shen, Miao, Leung, & Niyato, 2010)(Abdul-Rahman & Hailes, 2000) (Misztal, 1995). Researchers in the field of distributed systems have shown that trust and reputation management schemes can be effectively used to improve security (English, Nixon, Terzis, McGettrick, & Lowe, 2002) and aid in decision-making process. Hence, trust based systems can be used as a comprehensive security tool in addition to cryptographic mechanisms. The properties of trust are discussed by many researchers (Josang & Ismail, 2002; Misztal, 1995). They are summarized as follows.

- **Trust is Useful in Uncertain Environments:** Here, the participating entities cooperate to achieve a common objective. In a predictable environment, every user will know each other's ac-

tions and there is no need to compute the trustworthiness of other entities. Trust is useful in situations where incomplete information is available at hand.

- **Trust is Context-Sensitive** (Abdul-Rahman & Hailes, 2000): An entity A trusts another entity B for a particular action X. Alternatively, A may not trust the entity B for another action Y. It depends on the subject's capability for a context.
- **Trust is Subjective** (Ren, Li, Wan, Bao, Deng, & Kim, 2004; Josang A., 1998): The formation of an opinion about someone's trustworthiness depends not only on the behaviors of the subject, but also on how these behaviors are perceived by the agent. It also depends on the expectation of the evaluating agent on the subject's performance.
- **Trust is Asymmetric** (Abdul-Rahman & Hailes, 1997; Ren, Li, Wan, Bao, Deng, & Kim, 2004): An agent's trust in a subject is based on the knowledge that it has about the subject. This knowledge may be acquired either through the agent's own observations, the recommendations from the agent's friends, or other means. The subject may not necessarily know the agent and therefore may not trust the agent in this case. Thus, an agent's trust in a subject may not be reciprocated.
- **Trust is Dynamic** (Ren, Li, Wan, Bao, Deng, & Kim, 2004): The agent's evaluation of a subject is continuous and hence, the trustworthiness changes over a period of time depending on the subject's behavior. This dynamic real time view of trust will result in a more flexible model that resembles the social trust relations in humans. The positive outcomes of interactions will increase the trust, while negative outcomes lower the trust of a neighboring entity.

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