Chapter 5
On the Role of Game Theory in Modelling Incentives and Interactions in Mobile Distributed Systems

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ABSTRACT

Advances in wireless networking has led to a new paradigm of Mobile Distributed Systems (MDS), where data, devices and software are mobile. Peer-to-Peer (P2P) networks is a form of distributed system in which sharing of resources has some similarities to our traditional market in terms of goods and relationship. Game theory provides a mathematical framework for understanding the complexity of interdependent decision makers with similar or conflicting objectives. Games could be characterized by number of players who interact, possibly threaten each other and form coalitions, take actions under uncertain conditions. The players receive some reward or possibly some punishment or monetary loss. Our primary objective is to provide an insight into the role and suitability of game theory in the study of Economics of P2P systems. In order to achieve this objectives, we investigate different classes of game theory, review and analyze their use in the modelling of P2P system.

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INTRODUCTION

Distributed Systems is a form of computing paradigm that the applications and popularity has exploded over the years. Distributed system is a collection of autonomous computer systems connected together via networks and distribution middleware. These enable connected devices to coordinate their activities and to share the resources of the system, so that the users perceive the system as a single integrated computing facility. P2P network is a form of distributed systems that have received significant attention in recent years, due to the advancement in the world of information technology. P2P networks have inspired the design of social networking sites that made large scale interaction of people and businesses possible. Mobile P2P paradigm is a form of mobile distributed systems (MDS) that focuses on sharing of storage, software, and data amongst network devices. Peer-to-Peer (P2P) systems have been adopted as a viable alternative to client-server networks. This is due to the inadequacy of client-server architecture to cope with ever increasing demand for expansion and scalability. Servers in client-server systems sometimes constitute a bottleneck to expansion and attack on the server may results into a single point of failure. P2P system is a distributed system that eliminates partially or completely the need for a central server. A P2P system is described as a system that relies on computing power and bandwidth of nodes at the ends of a connection rather than concentrating on low number of servers within the network (P.Pradeep, Kumar, Shekar, & Krishna, 2012). In (Roussopoulos, Baker, & Rosenthal, 2004), the authors defined P2P systems as any network that exhibits the following characteristics: distributed control, self-organized and symmetric communication. There are many types of P2P systems, mostly used for large scale content distribution, file sharing, platform sharing, communication, distributed computation and collaboration. Peers in P2P networks are autonomous - the desire to do anything without external influence. This autonomy guarantee peers' independent activities; this may include voluntary sharing, free will entry and exit from the network, change of identity, honesty or dishonest dispositions to others and carry out trustworthy or untrustworthy transactions. Furthermore, peers in P2P networks have equal role. A server this time might become a client after a while. The features of P2P networks made modelling peers interactions a complex task. Incentives are incorporated in the design of P2P systems so as to: (1) Ensuring fairness among all participating peers. (2) Enhancement of cooperation, and (3) Alleviating the untrustworthy resources. Incentives have been identified to encourage cooperation amongst participating peers in P2P Systems. These incentives could be monetary such as digital coin and other kinds of non-priced incentives that designers deem fit. Incentives used in the literature are TTL (Time-to-live), bandwidth, service, delay times, network membership, peer rating