ABSTRACT

To select or change a service provider, customers use the best compromise between price and quality of service (QoS). In this work, the authors formulate a game theoretic framework for the dynamical behaviors of Service Providers (SPs). They share the same market and are competing to attract more customers to gain more profit. Due to the divergence of SPs interests, it is believed that this situation is a non-cooperative game of price and QoS. The game converges to an equilibrium position known Nash Equilibrium. Using Genetic Algorithms (GAs), the authors find strategies that produce the most favorable profile for players. GAs are from optimization methods that have shown their great power in the learning area. Using these meta-heuristics, the authors find the price and QoS that maximize the profit for each SP and illustrate the corresponding strategy in Nash Equilibrium (NE). They also show the influence of some parameters of the problem on this equilibrium.

Keywords: Genetic Algorithms, Learning, Market Share Game, Nash Equilibrium, Pricing, QoS

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1. INTRODUCTION

Recently, game theory has been widely used to analyze the selfish behavior of customers and service providers in telecommunications systems. Several studies have shown that the selfish behavior of customers leads to a typical prisoner’s dilemma situation that causes a network collapse. In the literature, a single decision action (e.g. the price) is commonly used for computing an equilibrium. However, it is necessary to include more than one parameter in the model to take into account the quality of service. The competition in terms of price and service quality between service providers entails the formation of non-cooperative games. We consider a game of several service providers, in which each player tries to maximize its own revenue. The whole system of SPs would have no incentive to deviate from the Nash equilibrium point. In this work, we present a model to calculate a bi-criteria Nash equilibrium (here, service price and quality of service) for several SPs. Then we will analyze the interactions between different SPs who won’t attract more clients and maximize their respective profits. Our model is mainly inspired from (Baslam et al., 2011b), where the authors have constructed a Markov model that derive the behavior of customers depending on the strategic actions of the SPs, to study a non-cooperative game for pricing problem considering QoS as an extra decision parameter. We base our study on the concepts of demand for services of a given SP. This demand given by linear function that depends on the vectors of prices and QoSs, is a commonly used function in research related to competitive network and equilibrium models (El-Azouzi et al., 2003, Baslam et al., 2011a), to calculate the reputation of an SP in the market.

Rationality is the most fundamental assumption in game theory’s works; every player looks to maximize its own utility (von Neumann and Morgenstern, 1944). In this context, the players know all the information about the game, i.e. there is a complete information. Therefore, we consider that all players are said to be rational and intelligent, i.e. every player acts in such a way as to maximize his or her expected payoff or utility as economists would say and can deduce what his or her opponent will do when acting rationally. In fact, humans use a propositional calculus in reasoning; the propositional calculus concerns truth functions of propositions, which are logical truths (statements that are true in virtue of their form). For this reason, the assumption of rational behavior of players in telecommunications systems is more justified, as the players are usually devices programmed to operate in certain ways. However, there are previous studies that have shown that humans do not always act rationally (Friedman, 1996). In this work, we describe the system model and specify the demand and utility functions introduced in (Baslam et al., 2012).
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