An Intelligent Particle Swarm Optimization for Fuzzy Based Heterogeneous Radio Access Technology (RAT) Selection

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ABSTRACT
The future wireless networks are heterogeneous in nature where different Radio Access Technologies (RATs) coexist in the same coverage area. The user terminal has to select the best access technology among Wireless Local Area Network (WLAN), Wireless Wide Area Network (WWAN), and Universal Mobile Telecommunication Systems (UMTS) etc. at its current location. Thus, selecting the appropriate RAT and cell becomes a complex problem in heterogeneous network due to number of variables involved in the selection process. The main objective of this work in the heterogeneous networks is to maximize the percentage of satisfied users who are assigned to the networks. Henceforth, this paper presents an innovative mechanism for the selection of heterogeneous networks such as WWAN and WLAN. The performance of the proposed algorithm is evaluated using 1000 datasets. From the simulation results, it is found that the proposed algorithm gives highest probability for mobile user satisfaction than the existing methods.

Keywords: Best Access Selection, Fuzzy Logic Controller, Multiple Objective Decision Making Algorithm, Particle Swarm Optimization, Universal Mobile Telecommunication Systems, Wireless Local Area Network, Wireless Wide Area Network

1. INTRODUCTION
The next generation wireless networks are heterogeneous in nature where different radio access technologies coexist in the same coverage area. The first generation communication systems lie on Advanced Mobile Phone Systems (AMPS) and Nordic Mobile Telephony (NMT) which are analogous in nature. The second generation systems like Personal Communication Systems(PCS), Global System for Mobile Communication (GSM), Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA) are digital in nature.

The Third generation systems like Universal Mobile Telecommunication System
(UMTS), CDMA 2000 based on Wireless CDMA technologies is to provide high speed wireless communication to support multimedia, video, data and voice. In turn, the perspective of beyond 3G systems is of heterogeneous networks which provide wireless services independently of its location in a completely transparent way (Marques et al., 2003). The user terminal has to pick the best access technology such as Wireless Local Area Network (WLAN), the Universal Mobile Telecommunication Systems (UMTS) and the Global System for Mobile Telecommunication (GSM)/Enhanced Data rate for GSM Evolution (EDGE) Radio Access Network (GERAN) (Ramraj et al., 2012) at its current location in order to use the technology with the desired service. The protocols used in different sections of the end-to-end communication relation from the point of view of service and transport functions of Next generation networks are discussed in Horvath et al. (2011).

The future wireless networks are heterogeneous in nature where different Radio Access Technologies (RATs) coexist in the same coverage area. Thus selecting the appropriate RAT and cell becomes a complex problem in heterogeneous network due to number of variables involved in the selection process. The main objective of this work in the heterogeneous networks is to maximize the percentage of satisfied users that are assigned to the networks by the given constraints and criteria. This research work presents an innovative mechanism for the selection of heterogeneous networks such as WWAN and WLAN. The main contribution of this paper is three fold. Firstly, four input parameters such as received signal strength, speed, network coverage, and Quality of Service are considered for the selection of the best access networks. These parameters are optimized by Intelligent Particle Swarm Optimization which optimizes the membership function of the parameters. Secondly, the optimized parameters are fed into the Fuzzy logic controllers and lastly the outputs are applied with hybrid multi objective decision making algorithm employing weighing function and particle swarm optimization for the selection of best access networks.

Several heuristics techniques (Rajesh et al., 2011) have been evolved to solve optimization problems. Some of the tools include Genetic Algorithm, Simulated Annealing, Neural networks; Particle Swarm Optimization appeared to be promising algorithms. The Particle Swarm Optimization (Goldberg et al., 1989; Sivandan et al., 2011) is used in this paper, because of following features of PSO i) It is based on swarms such as fish schooling and a flock of birds, ii) It is based on a simple concept and its computation time is short and it requires few memories, iii) All particles in PSO are kept as members of the population through the course of the run, iv) PSO has no selection operation and no crossover operation, and v) PSO is based on intelligence. Jeyarani et al. (2011) proposed a novel Self Adaptive Particle Swarm Optimization (SAPSO) algorithm for Virtual Machine Provisioning in Cloud. Tripathi et al. (2011) proposed wireless Sensor Node Placement Using Hybrid Genetic Programming and Genetic Algorithms.

In this paper, PSO is used for optimizing the membership functions of the fuzzy logic controller. Fuzzy logic provides a simple way to arrive at a definite conclusion based on vague, ambiguous, imprecise, noisy or missing input information. Fuzzy logic based methodology is good at explaining how to reach suitable decisions from imprecise and dissimilar information. Fuzzy logic strategies have been widely proposed in the literature in many different fields of knowledge. Taking this into account, this paper introduces the combined use of two intelligent techniques, fuzzy logic based methodology and particle swarm optimization for the selection of best access network.

This paper is organized as follows: Section 2 explains the related works, Section 3 explains about the overview of swarm optimization, Section 4 gives the overview of fuzzy logic controllers and Section 5 presents the proposed work. Section 6 gives the simulation results and Section 7 presents the conclusion.
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