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A Framework for Handoff Decision and Signal Selection Algorithms for Heterogeneous Network

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Abstract: ***The mobile and wireless communication technologies are launching much advancement every day to the mobile user. To make use of this advancement the user has to receive the signal properly. But because of the mobility nature of the mobile users the receiving signal strength is diminishing while the user moves away from coverage region of antenna. This problem has been reduced using handoff techniques. But the handoff decision and the efficient target signal selection should be done within short span of time. This paper proposes a framework which meets the above mentioned requirements for handoff.***

Keywords: RSS, Handoff, ANN, MIP, ACO, ACO 3Opt.

1. Introduction

Emerging innovation of mobile communication technology captivates number of users in every minute. The technology offers several services to the user. The problem to make use of those services is signal strength degradation because of the mobility nature of the mobile users. This problem can be avoided by doing handoff which can be done either as a horizontal handoff (within homogeneous networks) or as a vertical handoff (heterogeneous networks) [1]. To overcome this problem, handoff, that is handing of the current signal to the next available signal without losing the data, to be done. Several works has been done related to the handoff by considering different parameters. But the main issue of the handoff is decision time and selecting the efficient signal among the available one.

2. Framework

Handoff process can be categorized into three phases like System discovery, Handoff decision and Handoff execution [2,3]. This framework focuses only on decision making process. The initial step towards handoff decision is considered with multiple parameters and handoff triggering initiated based on RSS degradation and QoS requirements [4,5]. Both handoff requests had been done successfully. But the problem is with

RSS based handoff request. That is RSS based handoff is done immediately to the available channel without considering the QoS part of the target channel. So that, some handoffs were done unnecessarily. To overcome this problem when the handoff request is triggered the quality of the target signal is checked even though the request is because of RSS degradation.

Hence to solve the above mentioned problem all the parameters of QoS requirement and the signal parameters are trained in Artificial Neural Networks [6,7] to determine the optimal solution for the handoff decision making process. Since this is a machine learning approach, it can be initially trained with the available data, tested, and then it can be deployed in the actual environment. With this process the handoff necessity is estimated. If the handoff is to be done then the traffic type and signal strength is determined to select the optimal signal for handoff. The main advantage of this approach is that it can be trained continuously, even after deployment and can be fine tuned. Further, it provides us more accurate results as the usage increases. The downside of this approach is that in order to improve the accuracy of the system, it should be trained with all the available data, which is directly proportional to the time taken for the training. Hence as the number of training data increases, the training time increases.

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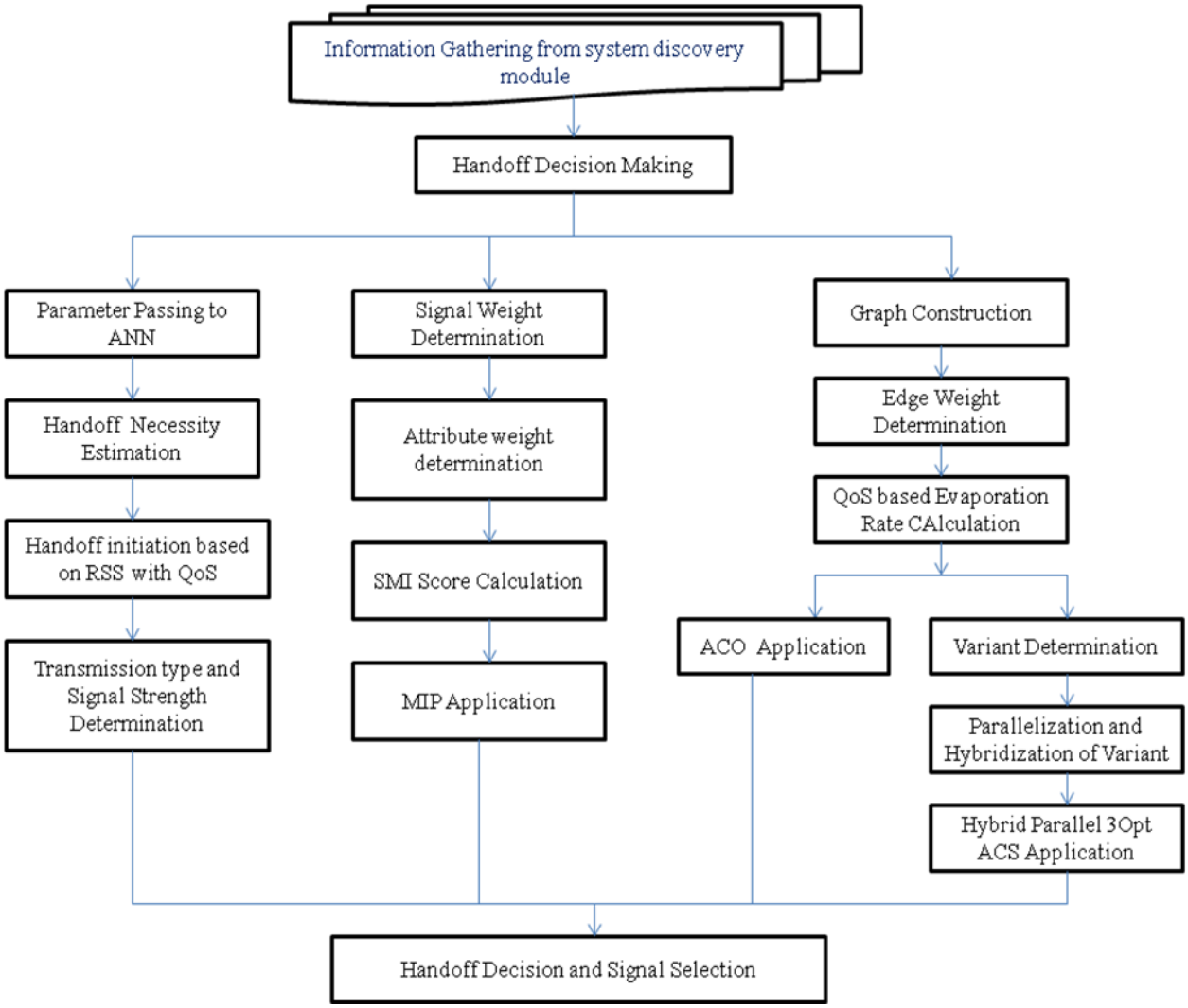

Figure 1 FRAMEWORK FOR HANDOFF DECISION AND SIGNAL SELECTION ALGORITHMS

To overcome this problem, genetic or meta-heuristic based methods can be used.

Next process considers Multi Criteria Decision making [8] by listing all the QoS requirements and are ranked according to the user requirements. The Mixed Integer Programming (MIP) model is used to determine the best channel based on the minimization or maximization of certain constraints. This is a statistical method; hence the available best solution can be expected of this method. But the downside of this method is that, it determines the solution by finding combinations of all available solutions and then short listing them to find the best solution. Even though it promises the best available solution, this method tends to be resource intensive and time consuming. Hence it can be used as a benchmark for determining the level of accuracy of the other methods.

A meta-heuristic method is a process that analyzes the available data and provides an optimal solution in a fixed time or after using a fixed amount of resource. This helps overcome the downsides of both the above mentioned approaches. The algorithm that we have chosen for the decision making process is the Ant Colony Optimization algorithm [WEI 09, YOU 10,ZHU 09]. The conventional ACO[8] uses only a single criteria for the decision making process. Since our problem at hand requires an optimization solution taking into account multiple criteria (QoS parameters), we use a modified form of the ACO with multi-criteria decision making process. The process of optimization begins when the call connection is initiated. The base node, the destinations and the ants are initialized, and the optimization process is carried out until call disconnection. WiFi, WiMAX and CDMA are considered as

the base signals. By the implicit nature of the ACO, we can guarantee optimized handoff.

The final contribution provides an efficient handoff decision making system using the metaheuristic based Ant Colony Optimization[11,12]. The variants of ACO are analyzed along with their parallel counterparts. Best results were found to be exhibited by the 3-opt variant in terms of accuracy and time during a vertical handoff. This algorithm is then hybridized by incorporating Simulated Annealing and Tabu Search to improve the results and reduce the time.

3. Conclusion

The framework initially considers RSS based handoff with quality signal selection. Then to select the best signal, statistical approach is used by providing various weights to the property of the signal as well as to the user requirements. ACO technique has been used to minimize the selection time and to select the optimal signal. Finally to fine tune the ACO method, three-opt method is proposed with hybridization to get improved results with minimum time. Hence to make use of the service offered by communication technology with this framework can be done successfully.

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