An Approach to Manage Handover Decision Process in Heterogeneous Networks Using Fuzzy Logic

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Abstract

Signal handover is the foremost thing in communication engineering task where decision making plays a crucial role by taking all the available attributes into account of distinct technology. In order to correlate dissimilar access technologies, vertical handoff algorithms came into existence in diverse forms. In pursuance of upgrading the accuracy of vertical handoff decision making for radio heterogeneous technologies, this work initiates multi criteria vertical handoff decision algorithm. Our work involves with the fuzzy logic controller with mamdani type inference engine by considering cost, bandwidth, throughput, received signal strength etc.., as semantic variables for different kind of networks and we also decide the index of networks which will be further utilized in handover management process for good decision making.

Keywords: Vertical handover; Fuzzy logic controller; cost; transmission range; throughput; bandwidth; received signal strength.

Introduction

There are different wireless technologies such as Wi-Fi, Wi-Max, GPRS, UMTS etc are available with different features. User generally expects best characteristics like low cost, high speed etc, while user is moving there is a chance of losing these best characteristics. But user needs seamless communication and better characteristics so there is a need of migration from one network to another network to achieve best features [1]. This process of migration from one network to another network is called vertical handoff. Handoff is basically of two types, one is horizontal handoff (handoff occurs in homogeneous networks) and second one is vertical handoff (handoff occurs in heterogeneous networks).

Vertical handoff involves three steps handover information gathering phase, handover decision phase and handover execution phase. In handover information

gathering phase, the information is collected and processed for making decisions [2].In the handover decision phase, recognizes need for handoff and selects the best network to be switched into. In last step i.e handover execution phase, establishes the connection with new network.

Number of algorithms has been proposed for making vertical handover mechanism in heterogeneous networks [3,4]. In our paper fuzzy logic based vertical handover algorithm with more effective parameters as the input instead of giving all attributes, it gives effective solution in handover by reducing unnecessary handoffs and gives best results to the users. Literature of the existing mechanisms assisted us to identify important parameters for vertical handoff decision; we have considered six important attributes as explained below.

i) Received signal strength:

Received signal strength is the strength of the signal received. RSS is very important specification while taking decision as it is directly reflects service quality [5] and it is one important specification while taking a decision for handoff.

$$RSS = C + I$$

Where C is carrier signal, I is interference signal.

For every network there is a predefined threshold value for received signal strength, when RSS value of a particular network is less than the predefined value then it require handoff. While defining threshold value to a particular network considerable interference also be taken into account.

If interference of a network is decreased somehow below the considerable interference, as a result received signal strength fall below its threshold value, so handoff will occurs which is undesired. If interference of a network is increased more than the considerable interference, as a result received signal strength raises above its threshold value, so handoff will not occur where it is a problem in making decision [6]. That's why, even though received signal strength is important criteria, this single parameter is not enough for complete decision.

ii) Bandwidth:

Bandwidth is defined as the range of group of frequencies. Bandwidth indicates the link capacity and more bandwidth facilitates more users to share the network resources [7]. Higher bandwidth ensures low call blocking and dropping rate. So, in handoff technique bandwidth is an integral part.

iii) Power Consumption:

All wireless devices works with battery, the running time of the battery is always limited. As battery level decreases, switch over to the network which provides lower power consumption, so that it provides longer usage time. While switching to the network to extend battery usage time [8], there should be enough received signal strength to continue communication properly.

iv) Transmission Range:

If the transmission range of the network is large, after connection established there is very little chance to drop the call before user terminates the connection. If the transmission range of the networks is small then there is a need of frequent handover. Large transmission range can't give guarantee to continue a communication without call dropping, why because fringe areas inside the transmission range also may not have good received signal strength for healthy communication. So there is need of good received signal strength as well as large transmission range.

v) Throughput:

Network throughput is defined as the average data rate transferred over a communication channel. Users always prefer a network with good quality of service and good throughput [9, 10].

vi) Cost:

Cost is also essential factor while considering handoff. The operator assigns links of high cost for users who are willing to pay more and link of the low cost networks to the other users.

The rest of the paper is organized as proposed scheme, simulation and results.

Proposed scheme:

The basic principle in decision making process using fuzzy logic is shown in figure1. There are three steps involved in it. First one is fuzzification, all inputs and its membership functions are mentioned and second part of the diagram is rule base, which decides the output depending upon the given conditions. The third part of the diagram is defuzzification, gives the output value again in terms of crispy values.

Membership functions can be defined as shown in figure2 in various ranges like very low, low, medium, high and very high etc. X-axis represents range of the input and Y-axis represents their magnitudes.
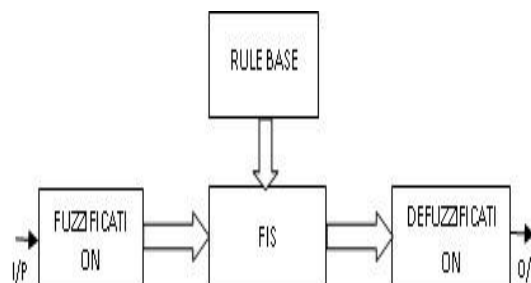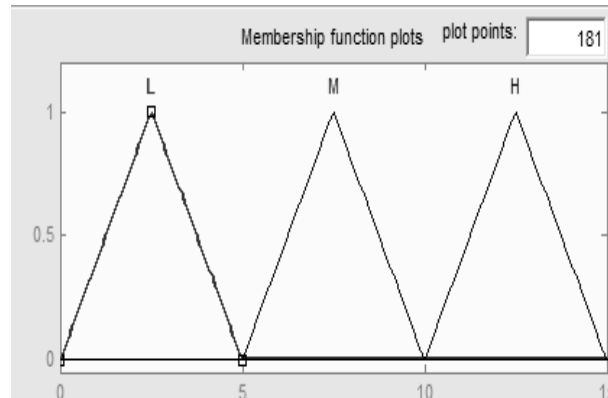

Figure1: Block diagram of proposed scheme

Figure2: Representation of membership function
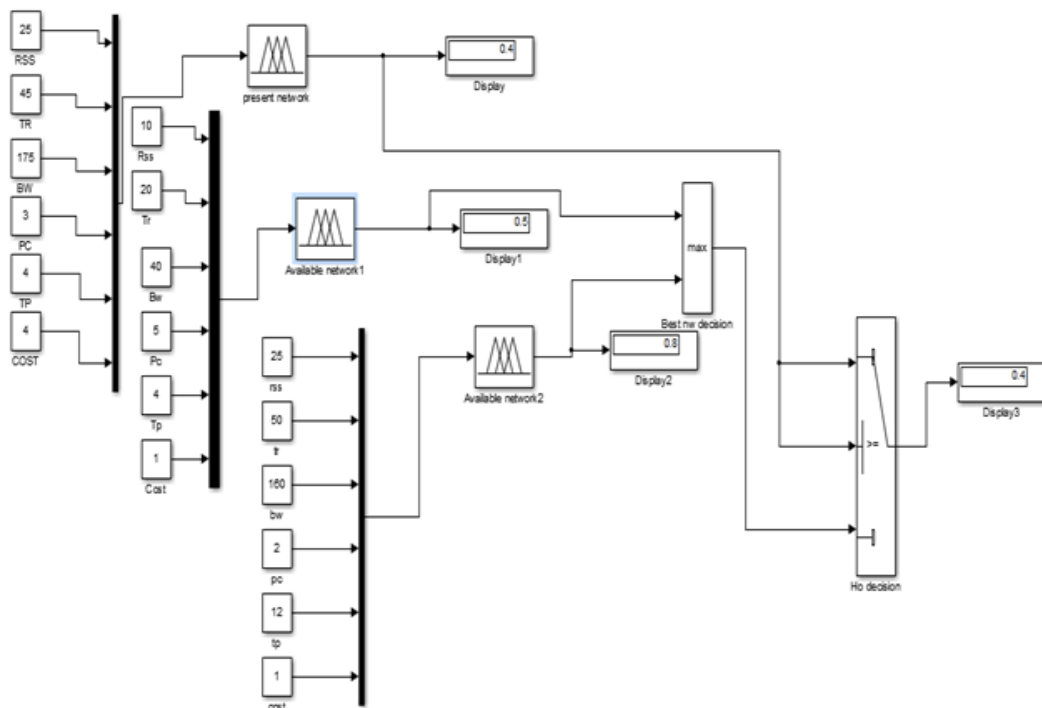
Results and Simulation

Network fuzzy logic controllers defined in open literature generates handoff factors at the same time by taking values of the given input parameters. In our proposed system, endmost section is threshold switch. This threshold switch has three inputs; first two inputs are connected from the present network and last input connected from a comparator. Comparator is a fuzzy logic controller which is useful in selection of the network where output value is large among available networks. Threshold switch pass through input one when input satisfies selection criterion otherwise pass through input three.

To generate results, proposed method can be carried out with simulation model. The required simulation model was implemented by using MAT LAB and overall design is as shown in the figures 3.1, 3.2 and calculated handoff factor values for three different networks using designed model were presented in figures 4, 5 and 6.

To generate results, threshold value for heterogeneous network taken as 0.3. From the results generated by designed simulation model, it is evident that, when the handoff factor is less than threshold value, output is to be taken from the available networks whose handoff factor is large. When handoff factor is equal or greater than threshold value, the output is to be taken from present network.
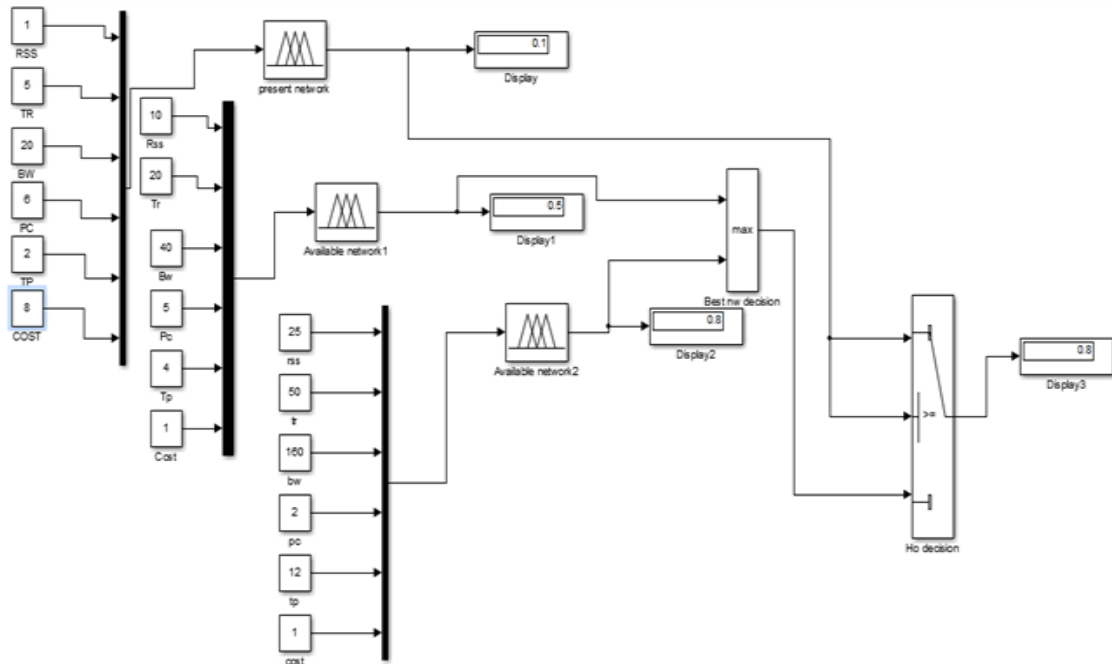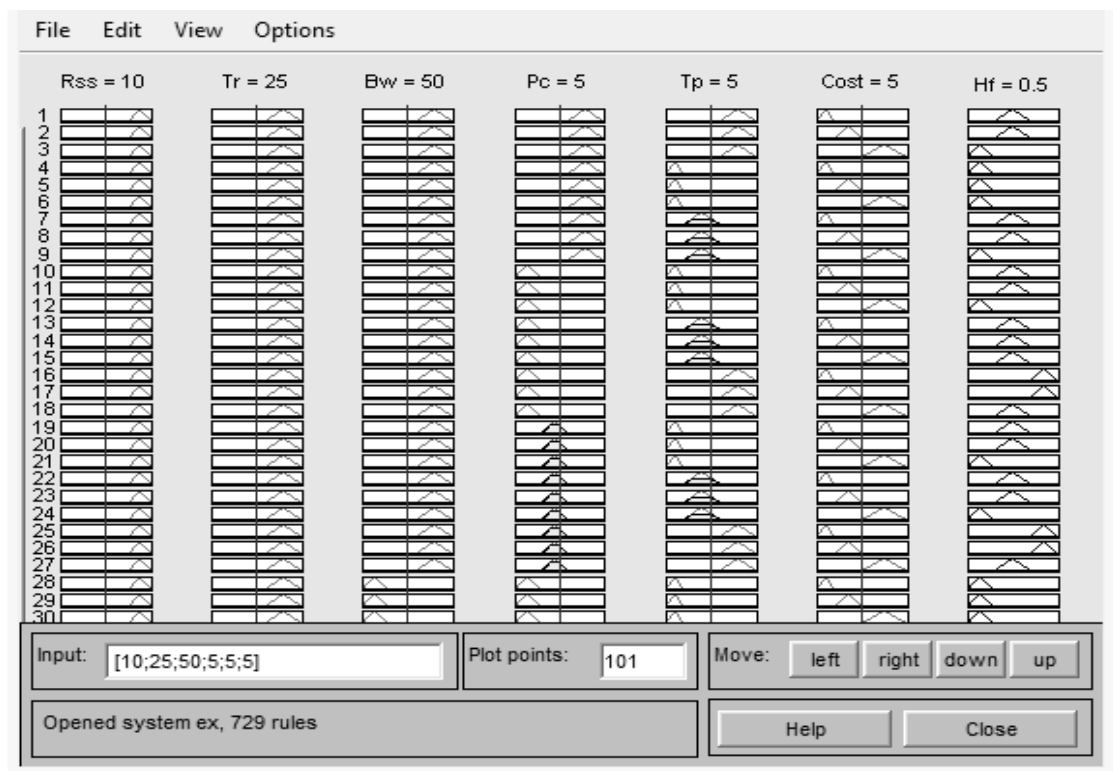
Figure 3.1: Proposed simulation model for vertical handover in heterogeneous networks.

Figure 3.2: Proposed simulation model for vertical handover in heterogeneous networks.
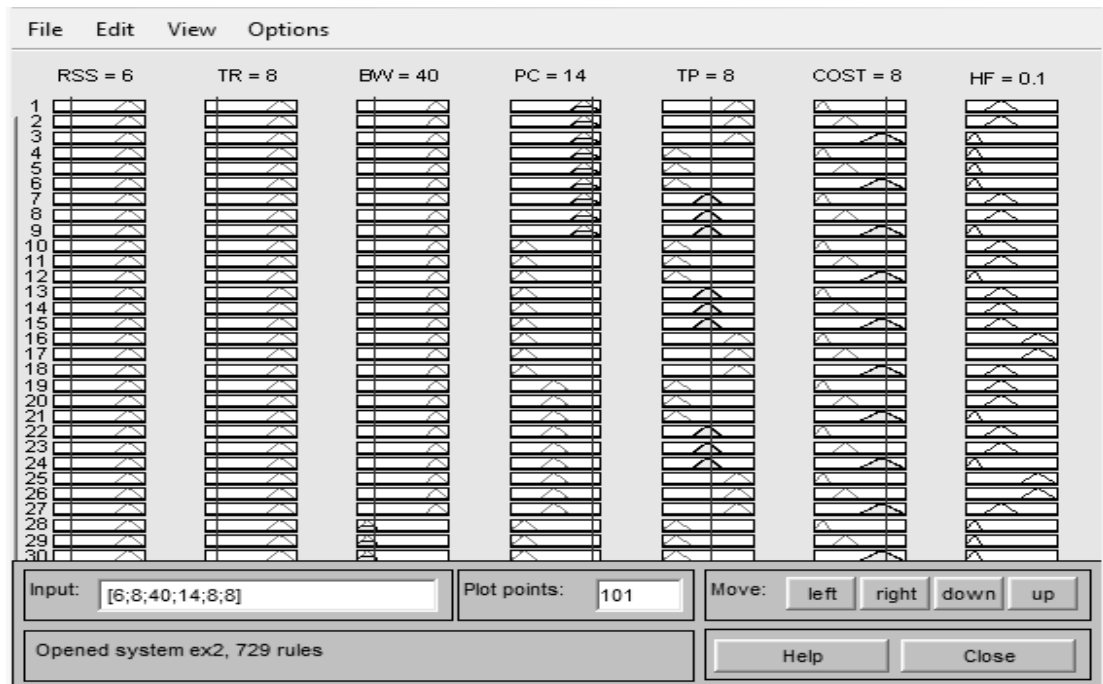
Figure 4: Simulation result for calculating handoff factor of present network.

Figure 5: Simulation result for calculating handoff factor of available network1.
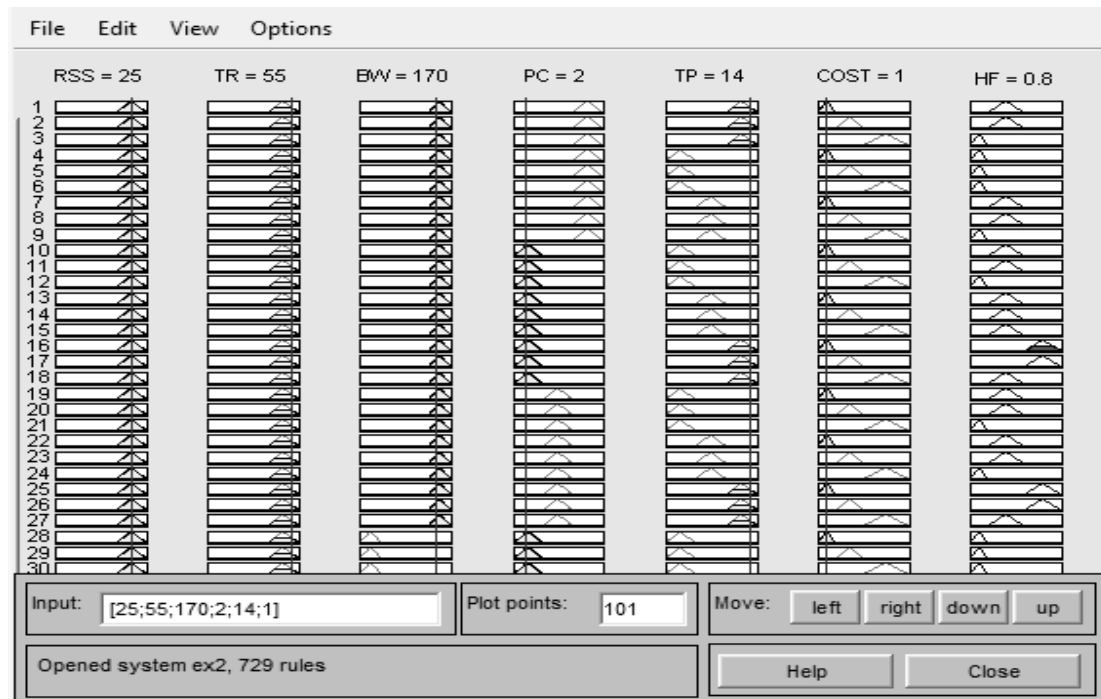
Figure 6: Simulation result for calculating handoff factor of available network2.

Conclusion

Fuzzy logic algorithms can give accurate solution to the vertical handover, when considering all the attributes of the network. By considering all the attributes of the network, writing rules will become tough task. So selection parameters for designing a vertical handoff mechanism are very critical. In this paper, effective parameters have taken as input, which are giving powerful solution to the vertical handover by reducing unnecessary handoffs.

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