# Effective Network Handovers using fuzzy Inference for Heterogeneous Mobility Management

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***Abstract*: omnipresent communication that is mobile increased capacity and appropriate quality guarantee for solutions. To meet up with these demands next-generation mobile network operators will deploy small cells next to old-fashioned base station structure intensively to enhance capacity and service protection for customers. Femtocell handover handoff techniques must make sure that seamless coverage is sensed by the individual when moving onto or off a femtocell. Femtocell handover is much tougher than normal macrocell cellular handover because the underlying network is different and there is certainly additionally small probability of direct interaction between femtocell as well as the macrocell. In this work handover management is done and the proposed scheme is compared to the existing scheme. The strength of Fuzzy Logic in handling uncertain and conflicting metrics is subjugated in this paper. The proposed Fuzzy Logic-based handover decision-making algorithm has the potential to offer a better quality of service to users in future wireless broadband communications. The result shows that the proposed scheme performs better in terms of execution time and power consumption than the existing scheme.**

***Index Terms*: Heterogeneous Networks, Handover management , Femto Cells, Fuzzy Inference.**

## I. INTRODUCTION

Due to the increasing demand for higher data rates it seems impossible to cope up with the increasing demand using the conventional macrocell networks. An efficient and viable solution to the problem has been found in femtocells[1]. In telecommunications, a Femtocell is a tiny, low-power home based cellular centre station, normally projected for use in a residence or tiny business. Femtocells are used in indoors to improve the coverage and data rates of the mobile users[2]. Consumers benefit from enhanced coverage as they have a base-station inside their building. However, Femtocells deployment may cause the incidence of frequent and unnecessary handover due to the movement of the user. As Femtocells coverage area is very small and deployed randomly, there are many possible targets Femtocells for handover[3]. Most of the researches are in the field of cellular networks focused on network-controlled horizontal handover where handover is executed between adjacent cells of the same network[4]. An appropriate vertical handover process is the essential requirement for seamless mobility in heterogeneous wireless networks. The role of the handover process is to select the best target network. Several factors such as number of decision parameters and their relationships affect the handover decision[5]. With the growing deployment of cellular networks, operators have to devote significant manual effort to network management. As a result, Self-Organizing Networks (SONs) have become increasingly important in order to raise the level of automated operation in cellular technologies[6].

In this work the innovative believed of Fuzzy Instituted handover decision for femtocells broadband cellular networks is proposed. It is critical for femtocells becoming self-governing and self-organized and able to the workplace lacking person intervention. We counsel Fuzzy Handover choice making come to be requested across training and femtocells to make handover decisions as a multi agent arrangement alongside the target of maximizing the contraption skill and not ever producing supplementary interference to the antiquated macro cell network.

In particular the disturbance in realistic wireless settings is paid down by method of Fuzzy Discovering methods that enable the femtocells to comprehend online and allocate the appropriate resource allocation strategy by constant contact alongside the environment. Though, Fuzzy Handover Mechanism is established on discrete representation of state and attention spaces, that makes the counselled way autonomous of the nature and designer criterion, as it needs a significant human interference in this of the state and deed spaces.

This method enables circumventing the subjectivity of the intelligent design alongside constant state and deed representation, as well enhancing presentation and convergence abilities.

This paper is organized as follows: Section II presents the related work. Section III presents the Methodology which explains the FIS used in this work. The Result is discussed in section IV. Section V concludes this paper and presents the Future Work.



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## II. RELATED WORK

Numerous fuzzy-based solutions for vertical handover decision systems have been proposed.

**A. Alhan and C. Eken[7]** proposed a fuzzy based vertical handover algorithm that considers minimization of the number of handovers while assuming RSS, data rate and usage cost as the primary decision parameters. The results show that the proposed algorithm can dramatically reduce the total number of handovers.

**Y. Chen, J. Ai and Z. Tan[8]** proposed a fuzzy-based vertical handover algorithm taking data rate, delay and BER (along with other parameters such as cost and security) into consideration is proposed. The algorithm improves the process of wireless network selection, thus avoiding unnecessary handovers.

**K. Vasu, S. Maheshwari, S. Mahapatra and C. S. Kumar[9]** proposed a QoS aware fuzzy rule based vertical handover mechanism that considers data rate, latency, jitter and BER. The proposed work is found to be effective for selecting a wireless network that meets the requirements of different applications. The results show a reduction in average end-to-end delay and yield a moderate average bandwidth. In [10] the problem of cell association and handover management in femtocellular networks is investigated.

Unlike the previous related work, a new approach is needed that allows an extended number of decision parameters to be included, considers QoS and minimizes the execution time.

## III. METHODOLOGY

### FUZZY INFERENCE SYSTEM

femtocells are required to be autonomous and self-organized, and able to work without human intervention[11]. Fuzzy logic is closer in spirit to human thinking and natural language than conventional logical systems[12].

Fuzzy Logic incorporates a simple, rule-based if X and Y then Z approach to a solving control problem rather than attempting to model a system mathematically. There are two Fuzzy Inference Systems: MAMDANI & SUGENO. In this work, MAMDANI FIS is used.

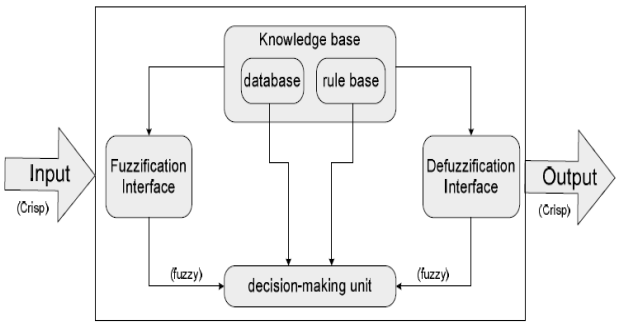
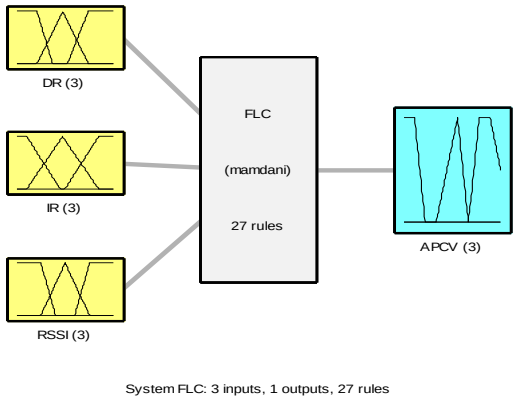



Fig: Fuzzy inference system.

Fig: MAMDANI FIS With 3 Inputs and one Output APCV




includes 27 Rules.

MAMDANI Fuzzy Inference System (FIS) takes three decision parameters as input.(1)Data rate[DR] (2)Interference Rate[IR] (3)Received Signal Strength[RSSI].In FIS, three modules are of key interest: Fuzzifier, a Rule base and a Defuzzifier. Fuzzifier converts external data into fuzzified data. The role of Defuzzifier is vice-versa. The core component of FIS is Rule base which contains IF-THEN rules. FIS generates aggregated fuzzified data, based on fuzzy inference method used.

MAMDANI FIS is characterized by the following fuzzy rule: **IF a is X then b is Y**

Where X & Y are fuzzy sets defined on the input & output domain respectively. This FIS calculates output i.e. Access point Candidancy values(APCV) using RSSI, IR & Data Rates(DR).

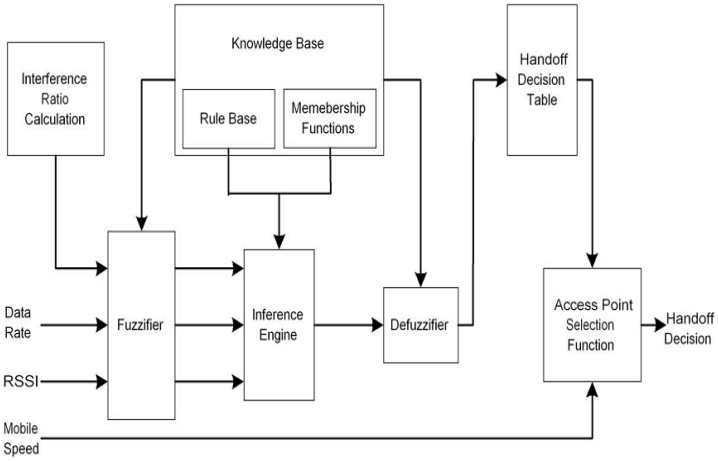



Fig: Proposed Working of Fuzzy based Handoff Decision

The algorithm merges the user request demands and web skills and creates an output that is utilized in order to make handoff decision and to select the most functional applicant Admission Point in femtocell. There are three inputs (data rate,



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interference rate, and RSSI) for Fuzzy inference system. Membership purposes of these inputs are given are going to be computed respectively. The sharp inputs are modified into the Fuzzy adjustable by way of these membership functions. During decision era whenever each AP can be acquired, the mechanism receives the handoff show packet and extracts the arrangement parameters that are working. It next invokes handoff that is fuzzy-based algorithm that seizes these parameters as inputs; procedures them; and can produce an output Access point candidacy value (APCV).

APCV can differ from one to ten whereas one denotes the weakest, whereas ten embodies the strongest candidacy degree of quantification. Each handoff initialization procedure is selected on this value(APCV).

There are 27 laws utilized for producing a new set of Fuzzy linguistic variables. For instance, Law 1 corresponds to the pursuing IF–THEN structure: if the possible AP supports low data rate, it is in a bad interference condition, and its RSSI is frail, next the APCV of the AP is 1, that way it is not a forceful candidate. On the supplementary hand, Law outputs a larger APCV worth, i.e. 10, which implies the APs candidacy level is quite high.

The output of the Fuzzy arrangement, APCV, is next joined to make handoff decision.

## IV. RESULT & ANALYSIS

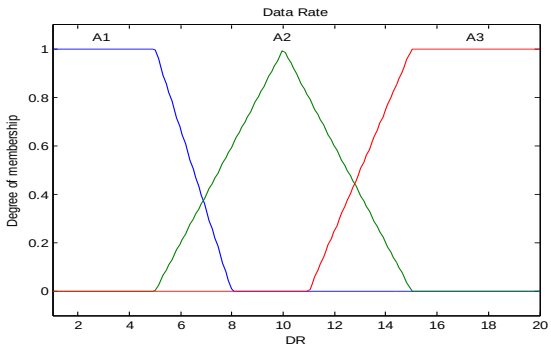


Fig: Data rate vs Degree of Membership in Fuzzy Relation with Three output Access Points (A1, A2, A3)

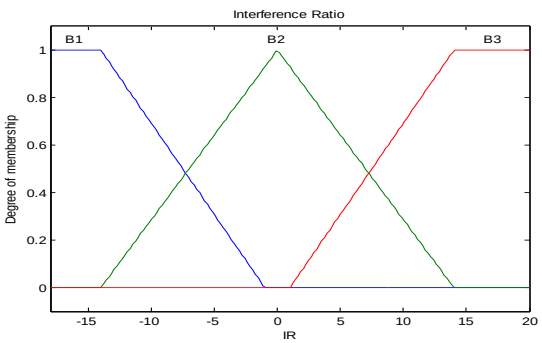


Fig: Interference Rate rate vs Degree of Membership in Fuzzy Relation with Three output Access Points (B1, B2, B3)

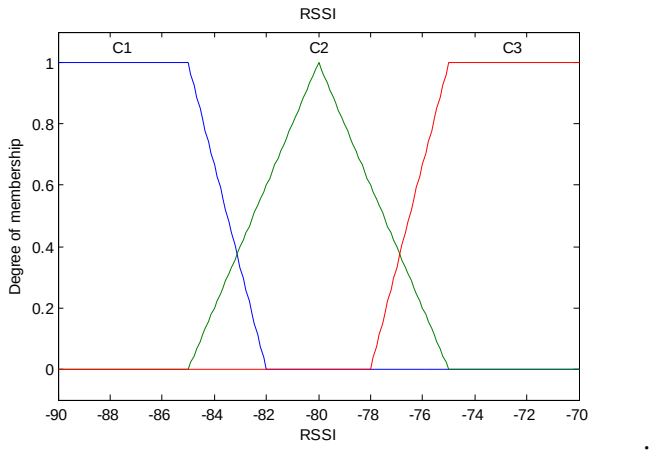


Fig: RSSI vs Degree of Membership in Fuzzy Relation with Three output Access Points (C1, C2, C3)

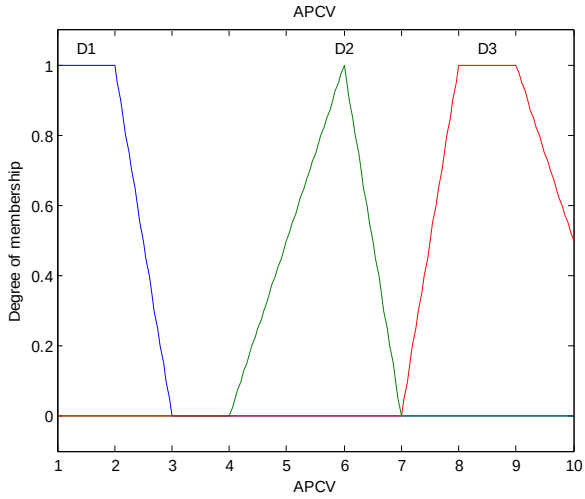


Fig: Access Point Candidacy Values calculated using RSSI, IR and Data Rates vs Degree of Membership in Fuzzy Relation with Three output Access Points (D1, D2, D3)

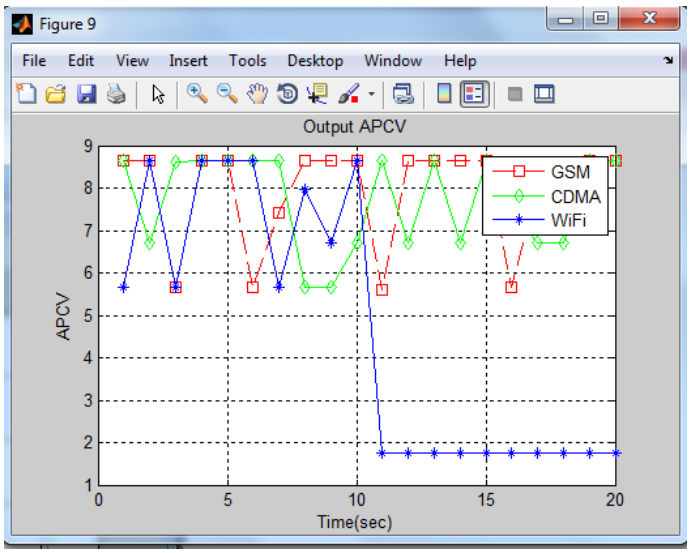


Fig: Combined Decisions in Multiple Signals using Fuzzy Handover Decision Maker



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In this work the innovative believed of Fuzzy Instituted handover decision for femtocells broadband cellular networks was proposed. We selected Three Disparate networks namely CDMA, GSM and WIFI. The FIS Handover arrangement was crafted on MAMDANI FIS System. The Inference Arrangement was able to Prosperously Find Appropriate Admission point for incoming Traffic, especially amid Disparate Traffic Types. It is critical for femtocells becoming self-governing and self-organized and able to the workplace lacking person intervention. The disturbance in realistic wireless settings is paid down by method of Fuzzy Discovering methods , that enable the femtocells to comprehend online and allocate the appropriate Handover decision strategy by constant contact alongside the environment. Though, Fuzzy Handover Mechanism is established on discrete representation of state and attention spaces, that makes the counselled way autonomous of the nature and designer criterion, as it needs a momentous human interference in this is of the state and deed spaces.

Below we have compared the proposed scheme(ANFIS) with the existing scheme(ATD) and it is found that the proposed scheme performs better in terms of execution time and power consumption.

The Execution time is measured in terms of seconds and the power consumed is measured in terms of watt-seconds.

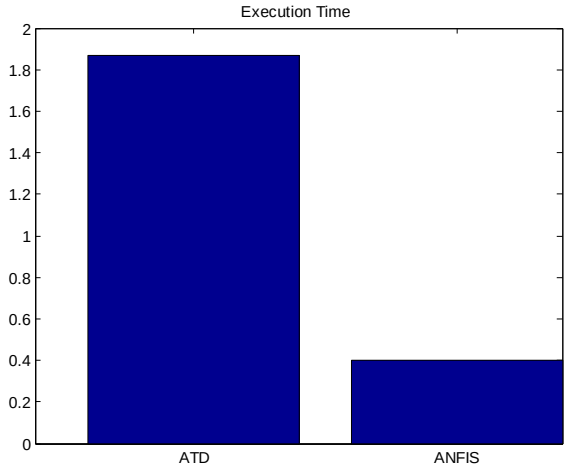


Fig: Execution time comparison of ATD and ANFIS based Handover Decision Making, AFIS works 2-3 time as Faster

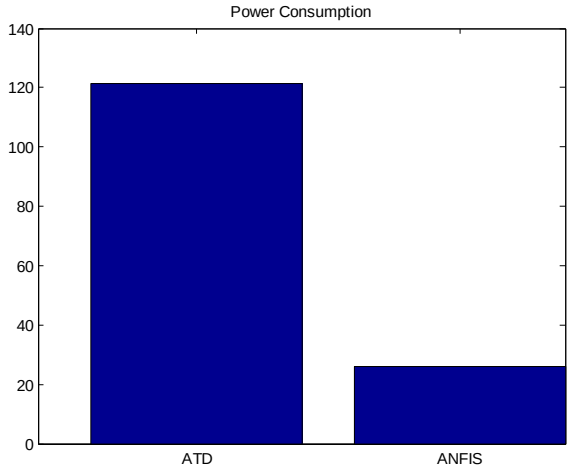


Fig: Performance Comparison of ATP and Fuzzy ANFIS based Handover Mechanisms, the ANFIS is Much more Energy Efficient

## V. CONCLUSION AND FUTURE SCOPE

In this work the innovative believed of Fuzzy Instituted handover decision for femtocells broadband cellular networks was proposed. We have Selected Three Disparate Networks namely CDMA, GSM and WIFI. The FIS Handover arrangement was crafted on MAMDANI FIS System. The Inference Arrangement was able to Prosperously Find Appropriate Admission point for incoming Traffic, especially amid Disparate Traffic Types. For Evaluation of the Fuzzy Ideal we have gave the state of fine art modelling of Femto cell arrangements employing MAMDANI Fuzzy Logic. Due to the lack of a public framework it stays frequently tough to differentiate the disparate Femtocell established models conceptually and assess their presentation moderately. All the NF models use gradient descent methods to discover the membership purpose parameters. For faster discovering and convergence, it will be interesting to discover supplementary effectual neural web discovering algorithms instead of back propagation.

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