Efficient Vertical Handoff Management in LTE Cellular Networks

Indu Bala[1]

[1]Student Mtech , Department of Electronics and Communication ,IGDTUW, Delhi, India

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Abstract - *Vertical handover based on the single criteria decision may cause inefficient handoff therefore multi-criteria handoff is gaining significance due to the enhancements brought by the mobility models in Fourth Generation (4G) technologies. Since the complexity and processing of multi-criteria during handover is a complex job requiring high handover time leading to the high packet loss and even breaking of connection as well. Moreover, However, these enhancements are limited to specific scenarios and hence do not provide support for generic mobility. Similarly, various schemes are suffered from the high packet loss, frequent handovers, too early and late handovers, inappropriate network selection, etc. In order to rectify these issues, this paper proposed a Neuro-fuzzy based vertical handover decision model in order to improve QoS in heterogeneous wireless networks. An improved handover strategy will also be applied to make the connection alive . Handover decision is based on triggers which are generated from different layers using fuzzy logic. We will use RSS, network load, available and required bandwidth and jitter as handover decision parameters.*

Key Words: **LTE, QoS, Vertical Handover, Fuzzy Based Handover Scheme.**

1.INTRODUCTION

Long Term Evolution is the next-generation 4G technology for both Global System for Mobile communication (GSM) and Code Division Multiple Access (CDMA) cellular carriers which is designed primarily for data rates. It is a wireless broadband technology designed to support roaming internet access via cell phones and handheld devices. Approved in 2008 with download speeds of up to 173 Mb/sec, LTE was defined by the 3G Partnership Project in the 3GPP Release 8 specification. LTE is a set of enhancements to the UMTS which was introduced in 3GPP Release 8. Much of 3GPP Release 8 focuses on adopting 4G mobile communication technologies, including an all Internet Protocol (IP) flat networking architecture. LTE uses a different air interface and packet structure than the previous 3G systems, including GSM's UMTS: Wideband CDMA (W-CDMA) and High Speed Packet Access (HSPA), and CDMA's Evolution-Data Optimized (EV-DO). However, it is envisioned that all GSM and CDMA2000 carriers will eventually migrate to LTE to provide an interoperable cellular system worldwide. Also, LTE provides enhanced peak data rates to support advanced services and applications. By the end of 2nd millennium there may be an exponentially expand within the quantity of users of second-generation cell network and web subscribers. For this reason, there have been extra expectations in achieving excessive knowledge price, capacity and exceptional services among the users of each the methods. To get to the bottom of the problems of ability and high information rate in the difficult radio atmosphere, a novel inspiration used to be proposed to make use of the a couple of element Array (MEA) at both ends of the wireless communication methods. These wi-fi methods had been referred as multiple enter more than one Output (MIMO) techniques having more than one transmit and more than one acquire antennas in literature in distinction with Single input Single Output (SISO) antenna systems [1]. A method having only one transmit antenna and multiple acquire antennas is talked about Single input a couple of Output (SIMO) approach whilst the system of a couple of transmit antennas and single receive antenna is known as multiple enter Single Output (MISO) method. MIMO is one of the most popular Advanced Antenna Technologies which is supported by LTE.

1.1 Advantages of Multiple Antenna Systems

A MIMO approach having transmit or acquire antenna elements in different contraptions is often called more than one Transmitters more than one Receivers (MTMR) [2]. To acquire an array or variety acquire, MIMO methods offers us more spectral efficiency and link reliability which reduced fading. Hence, MIMO offers higher throughput for a given bandwidth and higher link range for a given power value. MIMO science performs an important role in brand new wi-fi verbal exchange requirements reminiscent of 3GPP long run Evolution, 4G, Wi-Max , HSPA+ and IEEE 802.11n (Wi-Fi) due to having these houses [3].

1.2 Drawbacks of Multiple Antenna Systems

Clearly, the various benefits offered by multiple-antenna techniques do not come for free. For example, multiple parallel transmitter/receiver chains add to increased hardware costs. Moreover, multiple-antenna techniques might entail increased power consumptions and can be more sensitive to certain detrimental effects encountered in practice. Finally, real-time implementations of near-optimum multiple antenna techniques can be challenging job. On the other hand, remarkable performance improvements are seen in real-time testbeds over single-antenna systems. These demonstrations have shown that it can be achieved in practice using even low-cost hardware components.

1.3 Handover in LTE Networks

Over the last decade, a lot of researchers are emphasizing on enhancing the data rates and improving Quality of Service (QoS) to provide mobile users an uninterrupted service. Wireless networks, application and devices are undergoing a major evolution to achieve the high data rates. Because of the complexity of the wireless environment, no single technology can be efficient to provide mobile users with high data rate and good Quality of Service (QoS) over all situations. Indeed, to meet the increasing demand of mobile users, the use of heterogeneous wireless technologies has increased as it is allowing the users to be connected at anytime and anywhere. Heterogeneous wireless networks may incorporate different radio access technologies including GSM, GPRS, HSPA, UMTS, Wi-Fi, Wi-Max and even LTE which is becoming the new 4G standard for wireless communication. The main aim of the interworking of these heterogeneous networks is to provide high performances by achieving high data rate and supporting video telephony, streaming and multicasting with high QoS levels and uninterrupted internet services to the users . Several issues related to the heterogeneity of a such wireless environment should be addressed, namely, mobility and multi-homing management, resource allocation, security, high QoS support and seamless handover. Handover is the action of moving a Mobile Terminal (MT) from one wireless cell/technology to another.

1.4 Types of Handover

The handover process is divided into two categories-Horizontal Handovers and Vertical Handovers. The process denoted by the Horizontal Handover (HHO), is mainly based on the received signal strength (RSS) levels. With the emergence of a multitude of overlapping wireless networks, MTs have to switch their connections between different networks with different capabilities. In this case, the handover process is more complex and is denoted by Vertical Handover (VHO). Figure 1 shows a classification of the handover according three types:
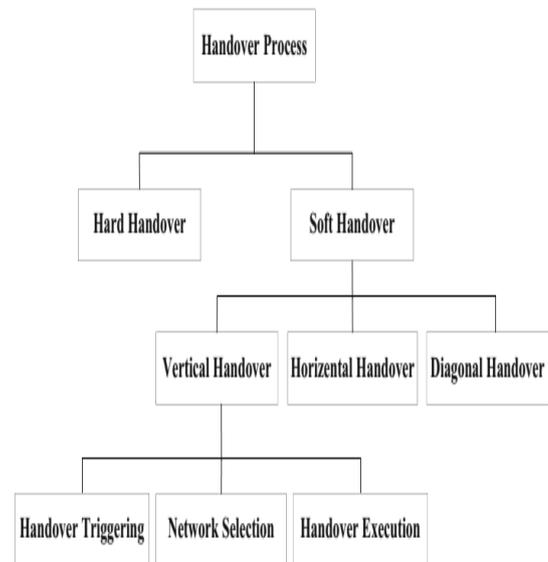

Fig -1: Classification and Process of handover

2. Result Analysis

This paper devise a method which uses Neuro-fuzzy hybridization resulting in a hybrid intelligent system that synergizes these two techniques by combining the human like reasoning style of fuzzy systems with the learning and connectionist structure of neural networks.

Neuro-fuzzy expert system collects input parameter values from event collector as crisp inputs and then evaluates them according to the predefined handover rules. The crisp input is then evaluated using rule base. The composed and aggregated output of rules evaluation is de-fuzzified and crisp output is obtained to make a Vertical handover decision. The Mamdani FIS implemented shown in figure 2 below.

This fuzzy rule based method works in the following manner. Initially, the mobile client periodically checks for the signal strength (RSSI) of the current network to monitor the condition for handover. When the RSSI of mobile client is going below the handover threshold, the available networks are examined at the mobile client. In the second step, the QoS parameters of the available networks are obtained either using MIH or GAN or both based on the available network set. In the third step, the best net- work is decided by using the proposed QoS-aware FRB vertical handoff mechanism based on the application QoS requirements obtained in the second step. Finally, the mobile is switched to the best network from the current network after making a decision using any mobility management protocol.
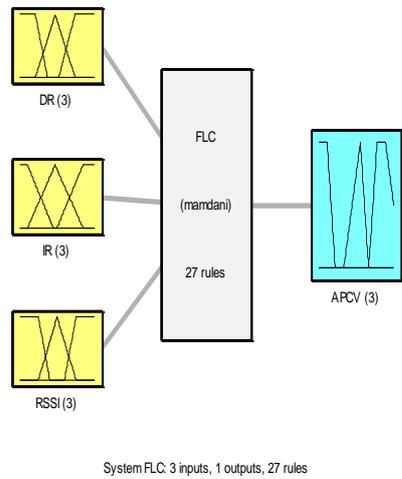
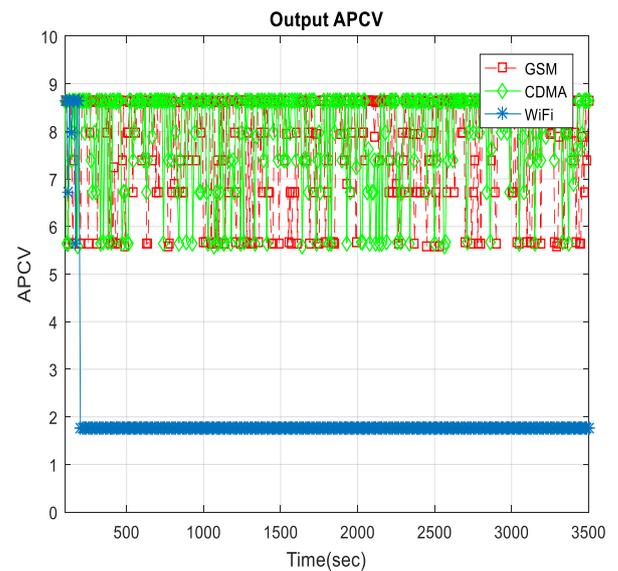**Fig -2**: MAMDANI Fuzzyfier with 3 Inputs and one Output APCV includes 27 Rules

The result of the one parameter i.e. data rate versus degree of membership in fuzzy relation with three output access points is shown in figure 3.

The handoff decision in various networks is evaluated using this technique by utilizing various input parameters such as data rate , Input range and RSSI in order to obtain one output value APCV.The figure 4 below explains the APCV versus time for different networks.

By analyzing the results we have observed that execution time of ANFIS is much more faster than fuzzy model shown in figure 5.
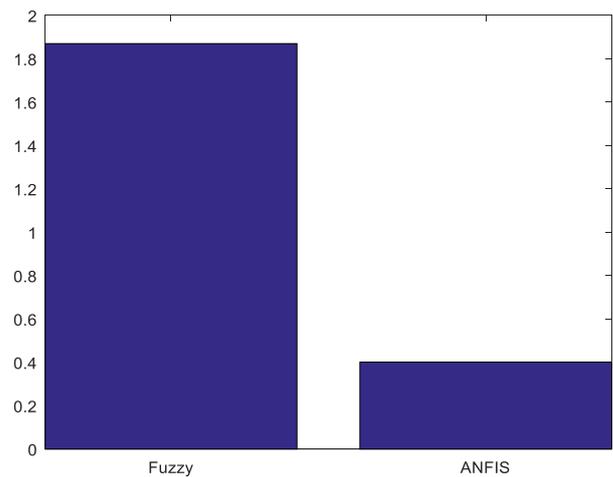

Fig -3: Data rate vs. Degree of Membership in Fuzzy Relation with Three output Access Points (A1, A2, A3)

Fig -4: Handoff Decision in various Networks

Fig -5: Execution time improvement in ANFIS model

3. CONCLUSIONS

From this paper,it is concluded that the innovative concept of Fuzzy Based handover decision using neural network for LTE Networks can significantly improve the QoS.We selected three different Access Points namely WIFI (802.11), GSM and CDMA. The FIS Handover system was built on MAMDANI FIS System. The Inference System was able to Successfully Find Appropriate Access point for incoming Traffic with 99.83% accuracy, especially between Different Traffic Types.

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