Combined Neuro-Fuzzy Vertical Handover Decision Criteria for LTE/LTE-A Networks

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Abstract: Vertical handover has gained significant importance due to the enhancements in mobility models by the Fourth Generation (4G) technologies. A handover decision scheme in LTE networks is either based on single or multiple criteria. The number of criteria directly depending on the total handover time. Similarly, the time required for selecting a target network during handover is also increased with the increase in a number of parameters. Traditional handover decision approaches are mainly based on the single parameter. But, with the introduction of heterogeneous wireless networks, the performance of these single parameter decision schemes is highly reduced. Therefore, researchers introduce multi-criteria handover decision schemes. The complexity and processing of multi-criteria during handover is a complex job and hence these schemes require high handover time which ultimately leads to the high packet loss and even breaking of connection. Moreover, these enhancements are limited to specific scenarios and hence do not provide support for generic mobility. To address the challenges, a generic vertical handover management scheme for heterogeneous wireless networks is proposed. A Neuro-fuzzy based vertical handover decision model has been offered in order to improve QoS in heterogeneous wireless networks. To keep the connection alive during handover an improved handover strategy has been offered.

Keywords: *LTE, QoS, Vertical Handover, Fuzzy Based Handover Scheme.*

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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. 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 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. 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. There may be an exponentially expand within the quantity of users of secondgeneration cell network and web subscribers by the end of 2nd millennium. 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. 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 unfold the whole transmit vigor over the antennas which offers us more spectral efficiency and link reliability which reduced fading. Hence, without increasing transmits vigour or bandwidth, we are able to gain high data throughput and hyperlink variety. 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 (WiFi) due to having these houses [3].

Clearly, the various benefits offered by multiple-antenna techniques do not come for free. For example, multiple parallel transmitter/receiver chains are required, leading 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 multipleantenna techniques can be challenging. On the other hand, (real-time) testbed trials have demonstrated that remarkable performance improvements over single-antenna systems can be achieved in practice, even if rather low-cost hardware components are used

2. Handovers in LTE Networks

Traditionally, the handover process has been studied between access points (AP) or networks using the same radio technology. This 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, Mobile Terminals have to switch their connections between different access technologies with different capabilities and characteristics. In this case, the handover process is more complex and is denoted by Vertical Handover (VHO). Figure 1 shows a classification ofthe handover according three types:

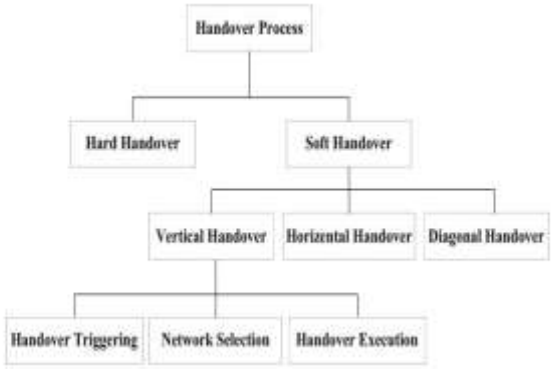


Fig. 1. Classification and Process of handover

2.1 Handover based on the behavior of a mobile terminal

This type of handover may be characterized in two ways, illustrated in Figure 1 in the case of cellular networks:

1) Hard handover

Hard handover is essentially a connection 'break before make ". The connection to the base station is completed before transfer to another access point [2]. Thus the mobile communication undergoes an interruption during the transfer process between two heterogeneous networks. Hard handover is seen as an incident during a connection.

2) Soft handover

Soft handover is also called handover led by the mobile. The source access point is retained and used for some time in parallel with the target access point. During this phase, the connection to the target is established before the connection to the source is broken, this mode is called "make before break".

3. Vertical handover

Vertical handover refers to all operations implemented to enable a mobile terminal to move from one network to another without loss of connection. For example, in a cellular network handover mechanism allows roaming between cells or operators. Among the causes that create a need forhandover, we can mention:

- The mobile node leaves the coverage area of the current cell and communicates through a new cell.
- The mobile node undergoes significant interference on the current cell hence the need to go on another cell (on the same network or a different network), where there is less interference.
- The number of mobile nodes in a cell is very large leading to a saturation of bandwidth and thereby causing deterioration of the quality of service. The mobile can choose to goin less congested neighboring cells.

Phase 1 : Handover Information Gathering

In this stage of handover's preparation and initiation, the mobile terminal detects available networks and their main characteristics such as the signal strength, the level of interference andthe bit error rate. Information may also be useful such the user's speed, the performance's terminal, and battery's charging rate. Taking handover decision will be based on this information. The scan this information may be either periodic or triggered by events

Phase 2 : Handover Decision

During the handover, the transfer's decision is the most important step that could affect the normal progress of the communication.. Improper decision can degrade the quality of service and even interrupt the communication in progress. In general, this step monitors the connection with the current network, it allows evaluating the need for handover, selecting a new network and estimating the accurate transfer time. Considering user preferences and characteristics of available networks, the adopted selection strategy allows each user to choose the most suitable network access from those available. This step leads to the instructions necessary for the implementation phase.

Phase 3 : Handover Execution

This phase is used to change channels toward new access point or base station (ap or bs) by following instructions provided in the decision phase. This phase takes place in three steps: connect to the target network, release the current channel and use the required authentication service. Once the best access network selected and authentication performed, the communication session will continue with the new network.

4. Proposed Method

The algorithm combines the user application demands and network capabilities and creates an output which is utilized in order to make handoff decision and to choose the most useful applicant Access Point in femto cell. Into the proposed handoff system, there are three inputs (data rate, disturbance rate, and RSSI) for fuzzy inference system. Membership functions of these inputs are given are going to be calculated respectively. The sharp inputs are converted into the fuzzy adjustable by means of these membership functions. Trim and trapezoid shapes are plumped for as fuzzy membership functions due to their particular capability of achieving better performance especially in real time applications.

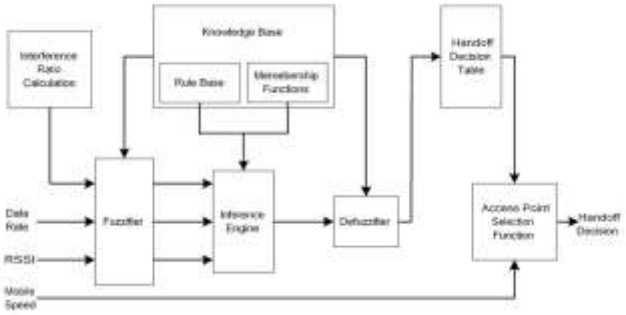


Fig 2: Proposed Working of Fuzzy based Handoff Decision

During decision period whenever any AP (Access Point) can be acquired, the device receives the handoff broadcast packet and extracts the system parameters that are working. It then invokes handoff that is fuzzy-based algorithm which takes these parameters as inputs; procedures them; and can produce an output called AP candidacy Value (APCV). APCV is generally defined by a real quantity in purchase to quantify the effectiveness of the candidacy level of the AP found. For instance, APCV can be designed to differ between one and ten where one denotes the weakest, whereas ten represents the strongest candidacy degree of quantification. Subsequently,
most of the aforementioned network parameters along with APCV are stored into the handoff decision table (HDT) for further usage.

5. Result and Analysis

A method for an intelligent handover decision mechanism among different radio access networks where the available network set is obtained dynamically at the mobile client comprises four steps as explained by the Block Diagram.

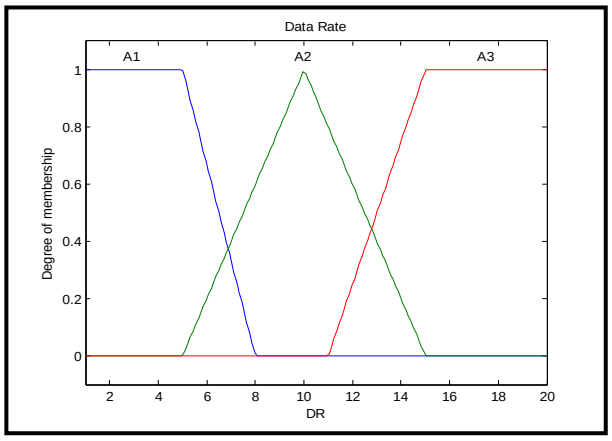
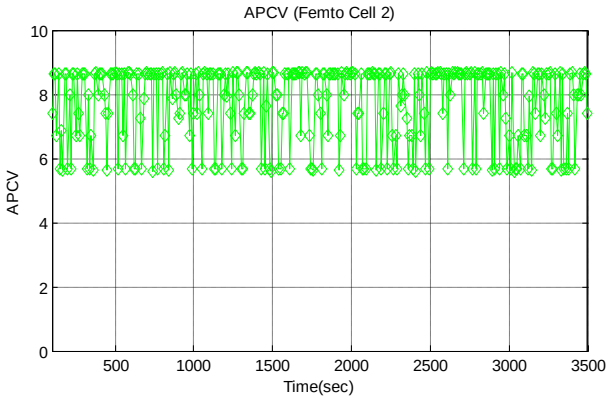


Fig 3: Data rate vs Degree of Membership in Fuzzy Relation with Three output Access Points (A1, A2, A3)



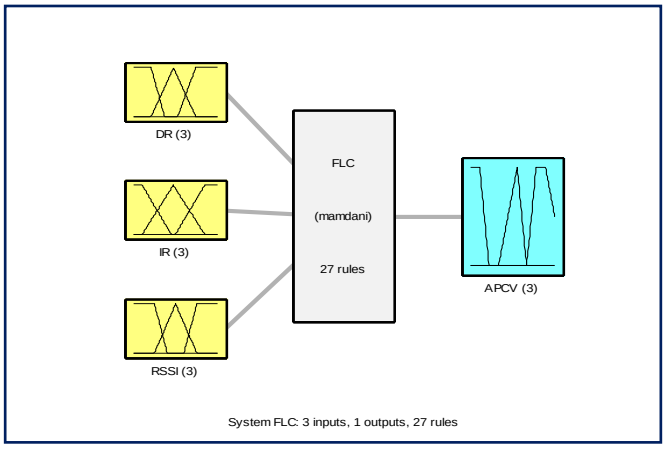


Fig 4 : MAMDANI Fuzzyfier With 3 Inputs and one Output APCV includes 27 Rules

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.

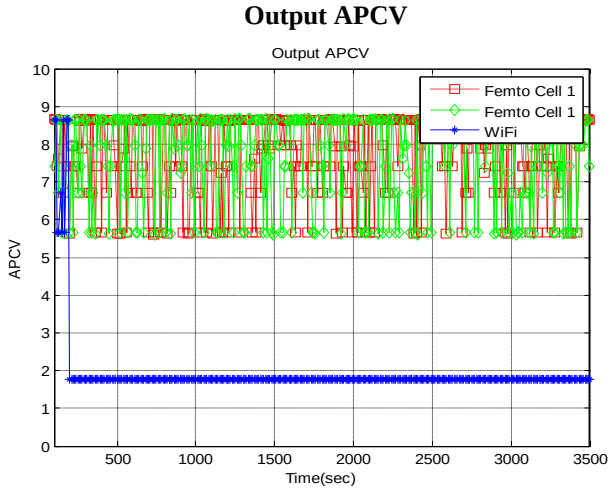


Fig 5 Handoff Decision in various Networks

1.8 Conclusion and future Scope

Using the reactive handovers for all handover procedures can significantly reduce the number of handovers in an urban LTE Network environment but for different users of variable velocities it will result in a much greater call drop probability as the delay in handover might be too long for the call to continue with decreasing signal to interference and noise ratio (SINR). On the other hand, use of all proactive handovers to reduce the call drop probability will significantly increase the number of handovers. So an optimization algorithm needs to be devised using the proactive, reactive and normal handovers which has been proposed later in the paper using the velocities of the users and their respective dwell times in the past cells. In this work the innovative concept of

Fuzzy Based handover decision for LTE Networks broadband cellular networks is proposed. We Selected Three Different Acess 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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