

ENHANCED VERTICAL HANDOFF MANAGEMENT FOR LONG TERM EVALUATION

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Abstract- Vertical handover benefit high-quality importance due to the enhancements in mobility models by means of manner of the Fourth generation (4G) technology. A handover preference scheme in LTE networks both based totally on single or more than one standard. The quantity of criteria is without delay depending on the general handover time. Further, the time required for selecting a goal community for the duration of handover is also accelerated with the boom in a number of parameters. Conventional handover choice procedures are in particular primarily based at the unmarried parameter. However, with the creation of heterogeneous wireless networks, the overall performance of those unmarried parameter choice schemes is rather decreased. Therefore, researchers introduce multi-requirements handover selection schemes. To cope with the ones annoying conditions, a familiar vertical handover manipulate scheme for heterogeneous wireless networks is proposed is needed. We proposed a Neuro-fuzzy primarily based vertical handover choice model for you to beautify QoS in heterogeneous Wi-Fi networks.

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

1.0 Introduction:

Long time period Evolution is the following-technology 4th generation for every Global System for Mobile communication (GSM) and Code Division Multiple access (CDMA) mobile agencies. Legal in 2008 with down load speeds of up to 173 Mb/sec, LTE changed into defined with the aid of the 3G Partnership undertaking within the 3GPP release 8 specifications. LTE uses a distinct air interface and packet shape than the previous 3G structures, collectively with GSM's UMTS: Wideband CDMA (W-CDMA) and excessive pace Packet get admission to (HSPA), and CDMA's Evolution-statistics Optimized (EV-DO). However, it is envisioned that every one GSM and CDMA2000 companies will ultimately migrate to LTE to offer an interoperable cell machine worldwide. LTE is a set of improvements to the UMTS which grow to be introduced in 3GPP launch eight. A whole lot of 3GPP release 8 focuses on adopting 4G cellular conversation technology, which incorporates an all internet Protocol (IP) flat networking architecture.

Similarly to the above, different LTE requirements and targets are listed beneath:

- **Bandwidth:** Scalable bandwidth of 1.25, 2.5, 5, 10, 15, and 20 MHz will be supported

- **Interworking:** Interworking with 4G UTRAN/ GSM superior facts rates for Global Evolution Radio Access Network (GERAN) structures and non-3GPP system shall be ensured. Interruption time for handover amongst Evolved UMTS Terrestrial Radio Access Network (E-UTRAN) and UTRAN/GERAN will be much less than 300ms for RT offerings, and much less than 500ms for NRT offerings.
- **Multimedia Broadcast Multicast services (MBMS):** MBMS could be similarly advanced and is then known as superior-MBMS (e-MBMS).
- **Rate:** decreased Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) such as backhaul will be carried out. Cost effective migration from launch 6 UTRA radio interface and structure could be viable. All of the interfaces specific shall be open for multi-provider machine interoperability.
- **Mobility:** Optimized for low cellular speed (0-15km/h). Better cellular speeds shall be supported (inclusive of high speed teach)
- **Spectrum allocation:** Operation in paired Frequency Division Duplexing (FDD) and unpaired spectrum Time Division Duplexing (TDD) is viable.
- **Co-lifestyles:** Co-existence in the equal geographical area and co-area with GERAN/UTRAN can be ensured
- **High-nice of issuer (QoS):** Surrender-to-prevent QoS will be supported.
- **Network synchronization:** Time synchronization of different network web sites shall not be mandated

2.0 Mimo Ofdm

There may be an exponentially amplify inside the quantity of clients of 2nd-era cell network and internet subscribers by means of manner of the quit of 2d millennium. For that reason, there have been extra expectations in achieving immoderate expertise charge, capability and high-quality services some of the customers of each the techniques. To get to the lowest of the problems of capacity and high data price inside the tough radio ecosystem, a novel idea was proposed to make use of the more than one detail Array (MEA) at each ends of the Wi-Fi communication strategies. These Wi-Fi techniques were referred as multiple Input Multiple Output (MIMO) techniques having a couple of transmit and a couple of acquire antennas in literature in distinction with Single Input single Output (SISO) antenna systems [1].

Multiple Access Technology In LTE:

Downlink and uplink transmission in LTE are based totally on the usage of a couple of get admission to era: in particular, orthogonal frequency branch multiple get right of access to (OFDMA) for the downlink, and single-service frequency department more than one access (SC-FDMA) for the uplink. The downlink is considered first. A. Downlink OFDMA is a variation of orthogonal frequency department multiplexing (OFDM), a virtual multi-provider modulation scheme that is notably utilized in wireless systems however relatively new to cellular. As opposed to transmitting a excessive-charge circulate of facts with a single carrier, OFDM uses a huge variety of carefully spaced orthogonal subcarriers which might be transmitted in parallel. Every subcarrier is modulated with a traditional modulation scheme (which includes Quadrature section-shift keying (QPSK), 16-Quadrature amplitude modulation (QAM), or 64-QAM) at a low picture price. The combination of loads or masses of subcarriers enables statistics rates just like conventional unmarried-carrier modulation schemes within the equal bandwidth. No matter the truth that OFDM has been used for many years in conversation structures, its use in mobile gadgets.

2.0 Downlink

OFDMA is a variation of orthogonal frequency department multiplexing (OFDM), a digital multi-provider modulation scheme this is widely utilized in wireless systems but tremendously new to cellular. In place of transmitting a immoderate-price flow of statistics with a single provider, OFDM makes use of a big type of cautiously spaced orthogonal subcarriers which is probably transmitted in parallel. Every subcarrier is modulated with a conventional modulation scheme (such as Quadrature phase-shift keying (QPSK), 16-Quadrature amplitude modulation (QAM), or 64-QAM) at a low picture rate.

while in comparison to the CDMA generation upon which UMTS is based, OFDM offers some of wonderful advantages:

- OFDM can without difficulty be scaled up to huge channels that are extra resistant to fading.

•OFDM channel equalizers are an awful lot less complicated to enforce than are CDMA equalizers, as the OFDM sign is represented inside the frequency area instead of the time area.

OFDM may be made absolutely resistant to multi-direction get rid of unfold. This is feasible because the lengthy symbols used for OFDM may be separated via the use of a shield interval known as the cyclic prefix (CP). The CP is a copy of the cease of a symbol inserted on the start. With the aid of sampling the received sign at the most positive time, the receiver can remove the time region interference among adjoining symbols as a consequence of multi-direction put off unfold in the radio channel.

2.2 Uplink

The immoderate top-to-common ratio (PAR) related to OFDM led 3GPP to look for a different transmission scheme for the LTE uplink. SC-FDMA become chosen as it combines the low PAR techniques of single-issuer transmission systems, which include GSM and CDMA, with the multi-direction resistance and bendy frequency allocation of OFDMA. A short description of SC-FDMA is as follows: information symbols within the time place are transformed to the frequency domain the use of a discrete Fourier rework (DFT); then within the frequency domain they're mapped to the preferred place within the everyday channel bandwidth earlier than being transformed decrease again to the time area the usage of an inverse FFT (IFFT). Eventually, the CP is inserted. Due to the reality SC-FDMA makes use of this method, it is once in a while called discrete Fourier rework spread OFDM or (DFT-SOFDM).

3.0 Vertical Handover method

Vertical handover refers to all operations achieved to allow a cell terminal to move from one community to another without lack of connection.

As an instance, in a cellular network handover mechanism permits roaming among cells or operators. A number of the motives that create a want for handover, we will point out [4]:

- The cell node leaves the coverage place of the contemporary-day cell and communicates thru a new mobile.
- The cellular node undergoes giant interference on the modern-day-day mobile eventually the want to head on every other mobile (at the equal community or a splendid community), in which there may be less interference.
- The wide variety of cellular nodes in a cellular could be very big major to a saturation of bandwidth and thereby inflicting deterioration of the high-quality of service. The cellular can pick out out to go in a far less congested neighboring cells.

In trendy, the handover method is carried out in three predominant steps:

3.1 Segment 1: Handover records amassing

In this degree of handover's schooling and initiation, the cellular terminal detects available networks and their crucial developments alongside the signal energy, the extent of interference and the bit mistakes fee. Every other statistics can also be useful such the user's pace, the overall performance's terminal, and battery's charging price.

Taking handover choice may be primarily based in this statistics. The test this information may be either periodic or brought on by activities [5].

3.2 Segment 2: Handover decision

At some level within the handover, the transfer's selection is the most critical step that would have an effect on the normal development of the communication.. Wrong choice can degrade the extremely good of company or even interrupt the conversation in development.

In trendy, this step video display devices the connection with the present day network, it allows evaluating the need for handover, choosing a modern network and estimating the correct switch time.

Considering individual opportunities and characteristics of available networks, the followed preference approach permits every user to choose out the maximum suitable network get right of access to from those to be had. This step results in the instructions critical for the implementation section.

3.3 Segment 3: Handover Execution

This section is used to alternate channels toward new Access Point or Base Station (AP or BS) by using following instructions supplied inside the decision section. This phase takes area in 3 steps: connect to the goal community, release the current channel and use the specified authentication carrier. Once the pleasant access community decided on and authentication accomplished, the communication session will hold with the brand new network.

3.4 Related Work

Chang B., et al. (2008) A heterogeneous Wi-Fi community includes diverse Wi-Fi networks [e.g. Worldwide Interoperability for Microwave Access (WiMAX) and Wireless Fidelity (WiFi)] and cellular communications [e.g. Beyond the Third Generation (B3G) and the Fourth Generation (4G)]. Vertical handoff is an critical mechanism for achieving non-stop seamless transmissions in these networks. In evaluation to horizontal handoff, vertical handoff considers now not most effective the Received Signal Strength (RSS) however also the provider-elegance mapping between handoff-in and handoff-out networks. Most previous works have adopted the RSS-based totally mechanism to decide handoff thresholds, which causes a extreme ping-pong effect that will increase unnecessary handoff. Although integrating the RSS-primarily based mechanism with a hysteresis method reduces the needless handoff, it suffers from excessive dropping [i.e. high Sum of Weighted Grade of Service (SWGoS)] and coffee usage. Therefore, a go-layer-primarily based adaptive vertical handoff set of rules with predictive RSS to reduce the useless handoff whilst drastically growing utilization and lowering connection dropping. The proposed technique determines the choicest goal network in levels, i.e., polynomial regression RSS prediction and Markov selection system evaluation. Furthermore, rapid adjustments in bandwidth because of vertical handoff bring about erroneous Transmission Control Protocol (TCP) congestion manipulate and, for that reason, reduce the TCP good put. The go-layer scheme gives a TCP receiver to reply to the TCP sender with the Wi-Fi network's protocol type. By the use of the go-layer records, the TCP sender can accurately expect the available bandwidth and growth the network good put. Numerical consequences imply that the proposed go-layer-based totally technique outperforms the opposite procedures inside the variety of vertical handoffs and SWGoS even as yielding aggressive utilization. In addition, the pass-layer scheme cooperates with current TCP algorithms to growth good put by as much as 18% [1]. After that **Shenoy N., et al. (2008)** Worked on communications networks are a aggregate of different wireless and stressed networks, which can be primarily based on an enriched set of technology. Wired networks are desired while the 'speaking' user's mobility or freedom to roam isn't a prime problem. However, given the busy schedules of human beings nowadays and the super increase fee in touring professionals, wireless networks are gaining popularity and arc turning into an integral a part of our lives? Research in progressive wireless technologies maintains inside the academia and industry as we are seeking for to provide enriched Wi-Fi offerings to cater to the necessities of the style of roaming users. Restricting the movement of a roaming user to a positive sector or provider issuer or interrupting a service because the consumer moved out of the administrative area of a wireless network will no extra be appealing, in particular considering Wi-Fi networks nowadays span the globe and provide a rich variety of offerings. Hence, presenting continued connectivity as users roam across one-of-a-kind wireless networks with proper fine of service is still a subject of excessive interest [2]. Then **Xiuhua Q., et al. (2008)** tells that 4G can be the certain route to the future radio and mobile communication gadget. A few center technologies of 4G cellular gadget covered safety approach, hybrid community and adaptive community in 4G. In this compare 3G and 4G from network structure, center community mobile terminal and the center technology. It is extensive to analyze and assemble 4G to a positive extent [3]. After that **Boysen E. S., et al. (2008)** presented overlapping networks offer opportunity Wi-Fi links like WLAN, GSM, 3G etc. Ideally, the person should be linked to the maximum appealing network any time in step with predefined priorities. This is performed with automatic handover. The maximum likely commercial application of this kind is designed for speech, and is the use of SIP to installation VoIP calls via WLAN networks or cellular networks. To make the handover time as short as possible is crucial to make it attractive. This is fine done by way of getting ready the opportunity networks before the handover is needed. This is known as proactive handover. This paper suggests modifications to a number of the primary SIP messages that open for proactive handover in SIP and assist reduce the delays when roaming [4]. Then **Alam Z., et al. (2008)** took Fourth Generation (4G) cellular structures and offerings will in particular be characterized with the aid of a horizontal communication model, wherein special get admission to technology consisting of mobile, cordless, Wireless Local Area Network (WLAN), brief-range connectivity, and wired systems may be blended on a common platform to supplement each different optimally for distinct carrier necessities and radio environments. To access special Wi-Fi networks, multimode user terminals are crucial. The maximum promising manner of imposing multimodal consumer terminals is to undertake the software program radio approach. The contemporary software radio generation does no longer meet the requirements of various wireless networks; because it is not possible to

have just one antenna and one LNA (Low Noise Amplifier) to serve the extensive range of frequency bands. The software program radio devices, after scanning the networks, will load the required software program and reconfigure themselves for the selected network. Each downloading approach has its very own advantages and drawbacks with appreciate to hurry, accuracy, resource utilization, and convenience. In this paper, the authors advocate a singular concept the use of CI/OFDM (Carrier Interferometry-OFDM) to get right of entry to more than one networks the usage of a wireless terminal. The bodily length of the Wi-Fi terminal proposed in the present work, might be smaller than the terminal with software program radio tool, and sufficient reminiscence may be inserted inside the terminal tool to store software program for all networks [5]. Therefore **Chang B. J. et al. (2009)** attempt a Heterogeneous Wireless Network (HWN) that consists of diverse wireless networks (e.g., WiMAX and WiFi) and cell communications (e.g., B3G and 4G), vertical handoff acts as an crucial mechanism for attaining continuous seamless transmissions and enhancing grade of service. As a consequence proposes an adaptive vertical handoff set of rules with predictive RSS to lessen useless handoff whilst increasing utilization and reducing connection losing appreciably. The proposed approach determines the highest quality target network in two levels: polynomial regression RSS prediction and Markov choice system evaluation. Numerical outcomes indicate that the proposed adaptive technique outperforms other methods in the range of vertical handoffs and SWGoS even as yielding competitive usage [6]. Therefore **Janevski T., et al. (2009)** took 3G cellular systems are at the floor imparting IP connectivity for actual-time and non-actual-time offerings. On the alternative aspect, there are numerous Wi-Fi technologies which have validated to be crucial, with the maximum important ones being 802.11 Wireless Local Area Networks (WLAN) and 802.16 Wireless Metropolitan Area Networks (WMAN), as well as advert-hoc Wireless Personal Area Network (WPAN) and Wi-Fi networks for virtual TV and radio broadcast. Then, the principles of 4G is already an awful lot discussed and it's miles almost positive that 4G will consist of several requirements beneath a common umbrella, similarly to 3G, but with IEEE 802.Xx Wi-Fi cellular networks blanketed from the start. The predominant contribution of this paper is definition of 5G (Fifth Generation) cellular network idea, that's visible as user-centric idea as opposed to operator-centric as in 3G or provider-centric idea as visible for 4G. In the proposed idea the mobile consumer is on the top of all. The 5G terminals may have software program described radios and modulation scheme in addition to new error-manipulate schemes can be downloaded from the Internet on the run. The improvement is seen in the direction of the user terminals as a focus of the 5G mobile networks. The terminals will have access to distinctive Wi-Fi technologies on the same time and the terminal ought to be capable of integrate exclusive flows from exceptional technologies. Each network can be responsible for coping with consumer-mobility, at the same time as the terminal will make the very last desire amongst unique Wi-Fi/cellular get right of entry to community carriers for a given provider. The paper also proposes clever Internet smart phone idea wherein the cell telephone can choose the great connections by using decided on constraints and dynamically exchange them during a unmarried give up-to-quit connection. The concept in this paper is essential shift inside the mobile networking philosophy as compared to present 3G and near-quickly 4G cellular technologies, and this concept is known as right here - the 5G [7]. Then **Twitchell Jr R. W., et al. (2009)** worked on more than one Standards Based Radio ("SBR") gadgets, every having a excessive-gain directional antenna, are applied in a far off sensor interface ("RSI") unit to optimize detection and reception through the RSI of radio signals from gateway controllers, hopping radios, and other wireless gadgets [8]. After that **Salameh H. A. B., et al. (2009)** took LTE deployment is one of the promising answers to fulfill the increasing needs on wireless services and packages. Based on deploying LTE inside the already-current Macrocell, LTE can improve indoor insurance and growth both spectral efficiency and statistics price. This development can be achieved with the aid of reusing the available spectrum assigned for the Macrocell, and being toward the customers. However, LTE deployment faces many challenges. One of the maximum difficult issues is the interference control difficulty. In this paper, a energy-manipulate channel task algorithm to manipulate the interference between LTE and Macrocell networks is proposed. The proposed algorithm lets in frequency reuse among LTE customers (FUEs) to offer better throughput overall performance. Simulation effects have proven an development in throughput by means of up to ninety% as compared to previous schemes [9]. Then **Gao F., et al. (2009)** presented about World Interoperability for Microwave Access (WiMAX) is a broadband wireless generation based totally on IEEE 802.Sixteen-2004 and IEEE 802.16e-2005. This thesis is a take a look at of WiMAX era and marketplace. The background of WiMAX development is brought and opportunities and demanding situations for WiMAX are analyzed within the starting. Then the thesis focuses on an overview of WiMAX generation, which addresses the bodily layer, MAC layer and WiMAX community structure. The deployment popularity is investigated in the fourth bankruptcy. Both product improvement state of affairs and marketplace popularity are mentioned on this phase. In the ultimate bankruptcy, the future development trend of WiMAX is addressed [10].

4.0 Handover Decisions in LTE Network

The actual handover among BS is a preference and the numerous schemes are classified consistent with who makes a selection, based totally mostly on which parameter and whilst is it performed. Most of the handover classifications right here are parameter driven, just so they make a diffusion based totally on the signs we cited in the preceding phase. As verified in the Figure Above, we encounter the numerous handovers conditions among FBS and MBS. In a group of LTE underlying a MBS, handover from a LTE to macro cell is less complicated as there are handiest few options. Enough planning is wanted to transfer a user to one of a group LTE in particular whilst maximum of them can offer excellent carrier and are available for resource allocation. In an open-get right of entry to LTE network, consumer may depart its serving MBS and switch to one of the FBSs.

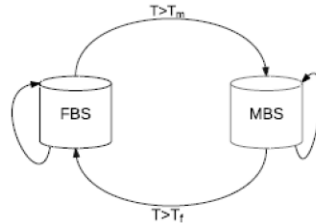


FIGURE 6.1: HANDOVER SITUATIONS

At the same time as huge quantity of neighboring LTE is to be had, a person has more than one selection for a new connection and some selections are better than others. As a result, it is required to research a way for cellular choice at some point of a handover manner as a way to maximize blessings of one potential and removal of redundant handovers.

4.1 Tough/smooth Handovers

Normally one imagines a switch of the patron with the aid of connecting to the subsequent BS after breaking its gift BS. This is referred to as a tough handover. Some services cannot manipulate to pay for an interruption among handovers. Mild handovers be part of the individual to the following BS earlier than breaking the service from the prevailing BS. Therefore the man or woman receives services from a couple of BSs concurrently.

4.2 Network/cell Managed

The recognition of the prevailing servicing channel needs to be continuously monitored. Almost all centralized networks have committed nodes to faucet in facts like congestion and bearer channels that deliver control indicators, synchronization sequences. Those are community controlled handovers in which the selection is based absolutely on the facts with the useful resource of the community on my own.

On occasion patron sends the recognition of the existing BS's sign incredible, specific indicators from acquaintances or its function. This is extra accurate because the information is real-time and vicinity primarily based absolutely than predictive. Although for collect this statistics, the UE wants to be clever and characteristic processing capability. These kind of handovers aren't exactly known as cell controlled due to the fact the operator has to still address the switch amongst BSs. We are capable of classify them as cellular assisted handovers.

4.3 Predictive Rerouting

Even though many parameters impact the first-rate of links, prediction is a robust useful resource for making plans. After examine of statistical records approximately handovers based on area, BS and studying for patterns make predictive handovers. Area primarily based take a look at must show a few regions to have many customers and multiple handovers. A strong BS handles greater requests from customers than a weaker BS. Even the examine of routes taken regularly permits layout congestion loose networks. This is predictive rerouting.

5.0 Result and Analysis

The membership function is a graphical representation of the magnitude of participation of each input. It associates a weighting with each of the inputs that are processed, define functional overlap between inputs, and ultimately

determines an output response. The rules use the input membership values as weighting factors to determine their influence on the fuzzy output sets of the final output conclusion. The membership function, operating in this case on the fuzzy set of interferometer coherence g , returns a value between 0.0 and 1.0.

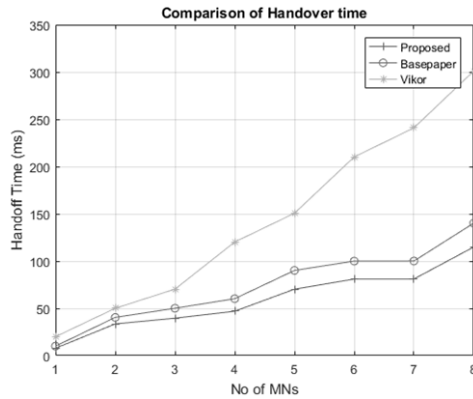


Figure 7.1: Handover Time

Figure show the Comparison of Handover Time and Handover Delay between last work done and proposed work which shows that there is more time in fuzzy based handover than Adaptive Neuro Fuzzy Inference System. As in MATLAB coding the result is concluded that there are 48 collisions in ANFIS.

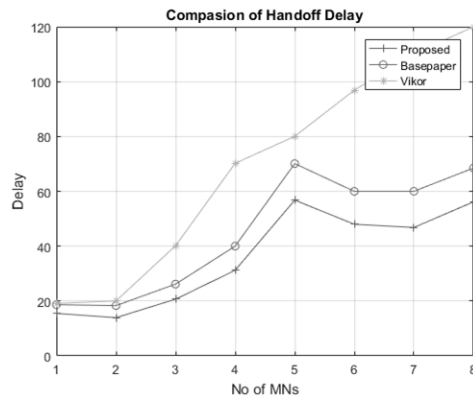


Figure 7.2: Handover Delay

Total error in fuzzy logic and Adaptive Neuro Fuzzy Inference System ANFIS are 2.71 and 0.17. Total accuracy in fuzzy logic and ANFIS are 97.29% and 99.83%. This comparison shows that Adaptive Neuro Fuzzy Inference System ANFIS has better output than fuzzy logic.

In this work the revolutionary concept of Fuzzy primarily based handover choice for LTE network broadband cellular networks was proposed. We selected 3 exceptional Access factors namely AP 1, AP 2 and WIFI.

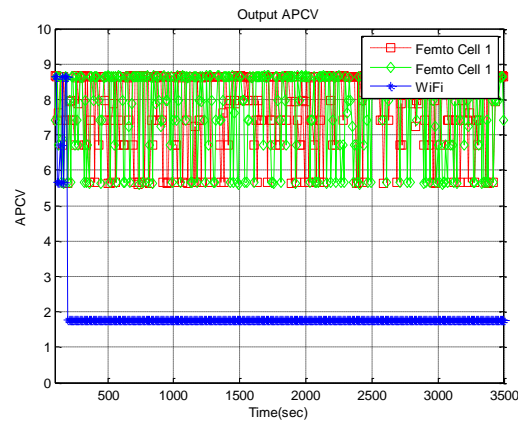


Figure 7.3: Combined Decisions in Multiple Signals using Fuzzy Handover Decision Maker

The FIS Handover machine turned into built on MAMDANI FIS system. The Inference gadget become capable of efficiently locate suitable access point for incoming visitors, mainly among extraordinary traffic types. It is miles essential for LTE network turning into self reliant and self-prepared and capable of the workplace without man or woman intervention. The disturbance in realistic wireless settings is paid down by using way of Fuzzy studying techniques, which permit the LTE network to apprehend on-line and distribute the proper Handover choice coverage with the aid of non-stop interactions with the surroundings. However, Fuzzy Handover Mechanism is primarily based on discrete representation of country and interest areas, which makes the proposed approach unbiased of the environment and clothier criterion, since it wishes a considerable human intervention in that is of the kingdom and movement areas.

6.0 Conclusion and Future Work

Using the reactive handovers for all handover methods can extensively lessen the range of handovers in an urban LTE community surroundings however for exquisite users of variable velocities it'll result in a much greater call drop possibility as the put off in handover might be too long for the choice to preserve with reducing signal to interference and noise ratio (SINR). However, use of all proactive handovers to reduce the decision drop opportunity will substantially boom the quantity of handovers. So an optimization set of policies desires to be devised using the proactive, reactive and normal handovers which has been proposed later in the paper the use of the velocities of the customers and their respective live instances in the beyond cells.

The innovative idea of Fuzzy based handover choice for LTE Networks broadband cell networks changed into proposed. We selected 3 unique Access factors namely AP 1, AP 2 and WIFI. The FIS Handover gadget became constructed on MAMDANI FIS tool. The Inference machine changed into capable of correctly discover appropriate access issue for incoming traffic particularly among special visitor's types.

Mixed effect of Angle of Arrival (AoA) and velocity on wireless channel, Channel data is affected significantly through AoA and velocity. Which will higher identify and Estimate the channel parameters which include line of sight (LOS), the combined effect of AoA and velocity may be investigated. Furthermore, a cutting-edge way of looking at the mobility idea in wireless community, it is known as movement intensity, can be included into analyzes of identifying and estimating numerous different Wi-Fi channel parameters site visitors kind recognition. Specifically in multi access Wi-Fi communications structures, site visitors type awareness will become greater important. Being aware about website online traffic type lets in schedulers better adapt themselves to changing interference situations.

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