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Handover in Mobile Wireless Communication Network - A Review

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Abstract— *Mobility is the characteristics of mobile communication that makes it irresistible by all and sundry. The whole world is now engaging in wireless communication as it provides users' ability to communicate on-the-go. This is achieved by transferring users from a radio network to another. This process is called handover. Handover occurs either by cell crossing or by deterioration in signal quality of the current channel. The continuation of an active call is a critical characteristic in cellular systems. Brief overview of handover, handover type, commonly used handover parameters, some methods employed in the literature and we present the convergent point for furtherance in the area of mobile wireless communication Handover.*

Keywords— Wireless Communication Network, Handover, GSM and CDMA.

I. INTRODUCTION

The major characteristics that made wireless cellular communication system WCCS an indispensable is mobility. Handover is the process of achieving Continuous service as the user moves in-between cells. Handover is needed during cell-crossing or/and signal quality degradation in the current channel. During handover, there is switching among networks and thereby transfer users to another network or BS [45]. The fundamental of 5G is heterogeneous networks and in such networks, seamless handover in non-negotiable [46]. Phases of handover are: discovery, decision and execution. Network discovery finds appropriate network that satisfies user desired QoS. Decision phase is when the handover should take place (also known as a handover initiation phase). These phases determine seamlessness of the handover. Wrong time of initiation leads to unnecessary handover or call drop rate is increased and thereby result to poor QoS. Therefore, handover should take place at the right time by trigger handover decision considering all the parameters properly to ensure QoS is not affected and unnecessary handover is avoided.

II. HANDOVER TYPES

The classification of Handover is based on the following factors:

(A) ACCESS TECHNOLOGY

- HORIZONTAL HANDOVER

This is also known as the Intra-technology handover and it is a handover between BS's of the same network interface e.g. 3G to 3G. This is common in a homogeneous system like GSM and CDMA networks.

- VERTICAL HANDOVER

This is also called inter-technology handover and it is a handover that occurs between two networks of different technology e.g. 3G to 4G. Vertical handover requires both layer 2 (Data Link layer) and layer 3 to complete the handover procedure successfully.

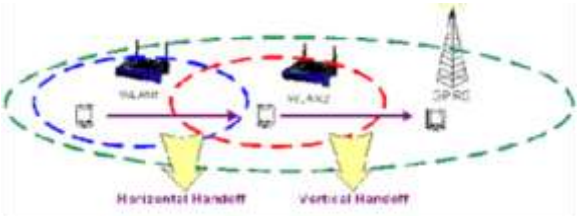

FIG. 1: Horizontal and Vertical Handover

(B) PROTOCOL LAYERS INVOLVED

- Data link layer-Based handover
- Network layer-Based handover
- Cross layer-Based handover

(C) TYPE OF TECHNOLOGY THAT THE NETWORK SUPPORTS

- Hard handover

In this type of handover, the serving station is released before new resources can be committed. Therefore, there is always a gap in the communication because; the mobile terminal cannot simultaneously communicate with the two access points (old and new).

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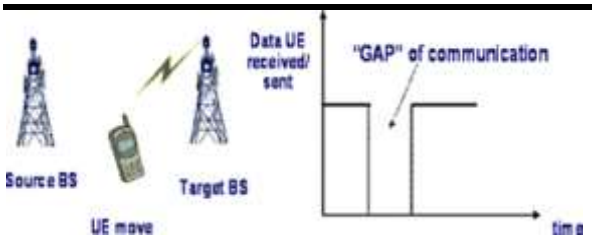

Fig.2: Hard-Handover Mechanism

- Soft handover

The mobile connection with neighboring BSnew is first established, after which BSold is released. With this algorithm, handover failure is reduced because a connection is established before breaking away from the old. It also offers a Fast Base Station Selection (FBSS).

- Softer handover

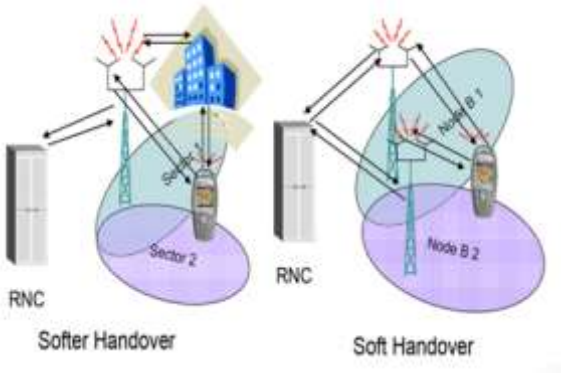

Fig.3: Soft and Softer Handover

This is slightly the same as soft handover except that it occurs between two different sectors of the same cell.

(D) TYPE OF INITIATING AND ASSISTING ENTITIES

There are two different things here, i.e. who initiate the handover and who control the handover process?

- Mobile_Initiated_based_Handover MIHO)
- Network_Initiated_based_Handover (NIHO)
- Network_Controlled_based_Handover (NCHO)
- Mobile_Controlled_based_Handover (MCHO)
- Mobile_Assisted_based_Handover (MAHO)
- Network_Assisted_based_Handover (NAHO)

Some of the commonly used parameters are: RSSI, SNR, Distance, Velocity, Network coverage, Delay, power consumption etc.

Signaling traffic results with a poorly designed handover scheme and eventually leads to poor QoS. Cellular communication system is divided into cell of a disjoint subset of frequency bands to avoid co-channel interference therefore, handover is needed. So, negotiation continues among mobile station, potential BSnew and BSold. The effect of handover in mobile communication is enormous. An ineffective handover leads to problems such as poor utilisation of bandwidth, system overload, call blocking, call termination, packet loss, and poor QoS.

III. REVIEW OF SOME LITERATURE

In [1], a fuzzy rule based algorithm which is QoS aware that uses bandwidth, E2E delay, jitter and BER as fuzzy inference system (FIS) inputs for handover decision making was proposed. The algorithm was simulated using Conversational, Streaming, Background traffic classes and Interactive. The algorithm gives better QoS performance where delay is less desirable. In [2], a vertical handover decision algorithm was proposed. It maximizes the overall MS battery lifetime and the algorithm also aim at traffic load balancing across the networks. This algorithm, according to [44], VHD function can be provided for a region covering one or more AP/BS when implemented in a multiple VHD Controller (VHDC) available in the networks. In [3], proposed a Received Signal Strength (RSS) based algorithm called ALIVE-HO (adaptive lifetime-based vertical handover) for decision making. With this algorithm, RSS was used to estimate wireless network coverage and selects the best network in it. The algorithm also employed MT velocity to reduce unnecessary handovers, and the effect of Ping-Pong but the HO Probability is directly proportional to distance from the access point. The algorithm proved better than traditional handover algorithm on the scale of the number of handovers. For vertical handover decision, QoS parameters and handover metrics are needed to be considered [4].

In [5], proposed a handover decision mechanism by formulating an optimization problem. A cost function was assigned to each candidate network. The choice depends on the lowest cost value. The criteria of cost function are handover delay, available bandwidth and power requirement. Each criterion is assigned with appropriate weight factor based on its important. In [6] proposed a utility based algorithm called Active Application Oriented (AOO) vertical handover decision mechanism. The quality of service parameters required for the applications is considered in the algorithm. Utility function is assigned to every associated candidate network and the highest utility value network is selected. The weighted sum of various normalized QoS parameters is called utilization function.

[7] proposed an algorithm which detects decay in signal using neural networks-based approach to make HO

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decision. In [8], Chan et al. proposed a multi-segment mobility management, which is based on packet through the concept of fuzzy logic and Mobile IP.

W. Zhang in [9] proposes a VHD decision which is formulated using "fuzzy-based multiple attribute decision-making (MADM) problem". Fuzzy logic is employed to handle the imprecision in the formation of some attributes of the networks and the user's preferences.

In [10], a "Markov decision process (MDP)" is proposed for VHO decision making. The approach considered many parameters like network conditions, user preference and device capability. A lot of VHD algorithms have been developed and many of which employed Fuzzy logic theory which has shown greater advantage over traditional (single parameter based) algorithm which has no database to store rule bases.

Mali 2017 [11] proposed a Fuzzy Based VHD Controller for Future Networks targeted on network selection during handover processes. The author considered more than fifteen (15) parameters and divided the handover process into six systems (A - F). System A provides available networks report at mobile device periodically and their respective QoS parameters. System B at the base station receives these parameters and feed it to the next stage. System C retrieve the data from the stack if system B and feed system D to set the fuzzy rules. E is called knowledge base module and the decision is taking by F. The method solved the problem of latency and reduces the call drop rate. Meanwhile, there is need to integrate more and more parameter into the controller for more accuracy.

In [12],DebabrataSarddar et al proposed a GPS based handover technique for handover probability enhancement in NGWS (Next Generation Wireless System). The authors used GPS to determine the direction of the velocity of the MT (Mobile Terminal) and thereby ensured efficient hand-off. The efficiency of this work is dependent on if at different time interval the angles are stored in memory and compared for a specific time interval means for perfectness we required huge data with huge memory capacity. In [13],Wonjun Lee et al proposed a handover algorithm based on mobile user movement MAV (Movement Aware Vertical handover). It uses patterns of movement to avoid handovers between WLAN and Mobile WiMAX networks when it is not necessary. In the MAV, the dwell time adaptively changes and the targeted base station (BS) predicts the residual time. MAV provides better connection to MS as long as possible. The work is effective to handover Ping-Pong effect through dwell time, but it required to cover the detection technique of actual cell boundary also consider coverage based mechanism for efficient handover. In [14], Dong Ma et al also proposed a QoS-based VHO algorithm for WLAN and WiMAX which uses bandwidth estimation algorithm. This scheme evaluates the overlay networks real-time status to makes a handover decision. The deficiency of the proposed algorithm was that handover process will be initiated by unaccepted signal strength which will produce unsatisfied QoS parameters. For effective QoS handover, there is need for latest parameter in order to maintain QoS like network cost, load balancing and so on. In [15],P.Vetrivelan and P.Narayanasamy, a "seamless media independent resilience triggering (SMIRT) framework" for HetNets (Wi-Fi, WI-MAX and LTE) is proposed which employed soft-handover mechanism. A seamless roaming is provided through the MIR-HO framework with user's exclusion in a HetNet by the proposed method. One of the key factors of resource utilisation efficiency is call admission control (CAC). This is being performed during either new call or handover communication. In this, when the BW (bandwidth) is not sufficient for call admission, the bandwidth will be adaptively allocated to accommodate the call. But, there is need for effective and unique algorithm which will cover every issue and take an effective decision within a short time also unnecessary handover situation is not considered. In [16], Wang et al proposed policy-enabled handover algorithm. The users set some rules which determine the best network based on the network parameters (dynamic and statics) thereby present the cost function. This algorithm is not capable to handle sophisticated configuration. In [17],E.Stevens,Wong proposed VHD algorithm for heterogeneous network by using duration of connection and load signaling to perform vertical handover. The algorithm uses MDP to maximize total reward of connection expected. The algorithm reduces the number of VHO expected when compared with methods like simple additive weighting (SAW) method and GRA (grey relational analysis). In [18],Dvir et al HO algorithm for HetNet is proposed. A decision function is based on host velocity, battery status, current load on the network and so on as related to the available network. The new system-wise-entity is defined when UE moved to the overlapping region. Then,, the technology selection is carried out by the entity to optimize the system performance. In this we required to cover the parameters which detect the false situation also along with all latest parameter.

In [19],Chandralekha et al proposed a best wireless network selection theory which is based on the preferences set by the UE. The network with a reasonable performance rate is

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selected. The selection must be done carefully because it is the selected network performance rate is used as input to NN so that the performance rate might be high. In [20], Goyal et al proposed a VHO model which is dynamic across HetNet. The algorithm selects the best network using RSS, velocity of a mobile node and statics factors. The algorithm has three phases which are: the priority (used for the removal of ineligible network), normal (used for accommodating user predefined preference) and decision (used to select the best network). The network interface and base station parameters are monitored by HMC (handover Management Centre), analyze it and make HO decisions. There is need to develop functions which relate received signal strength (RSS) with velocity in order to utilize it with other factors effective handover. In [21],AratiRana et al proposed a vertical handover method which reduced the network latency. The access router periodically send router advertisement which is analysed when a mobile moves from one BS place to another BS, a care-of address is generated through communication with the subnet of that particular network which is then configured in the eNB. Verification of duplicate address is carried out by the UE to check for duplicate address in the same radio range. A reconfiguration of the new care-of address is carried out if there is any duplicate address. The algorithm is time consuming therefore, the latency is affected. According to [9], to switch from one network to another without disconnection the latency should be as minimum as possible. [22] Sanjay et al proposed a requirement of vertical handover mechanism. Vertical handover is a critical component of forth generation (4G) networks. This is because of the switching amongst HetNets. This poses serious HO challenges as a result of its multiple requirements for VHO. Above proposed parameters are not sufficient for taking efficient decision of vertical handover. Actually, it needs to consider lot many statics and the dynamics parameters of the network too.

In [23],Tokekar et al proposed handover technique which depends on static and dynamic parameters. The static signal strength is not always sufficient to initiate the handover process and therefore network load, type of application, speed of the mobile node (MN) may be considered along with it.

In [24],kolipaka et al combined wireless mesh network architecture and joint admission control with VHO algorithm with a case study of WAN and WiMax. QoS is guaranteed by handing over to another network to support the traffic flows in WLAN. The E2E delay and throughput is improved with this algorithm. It is noteworthy that the algorithm focuses on QoS, but there is also need to reduce the number of handover (network latency) and which type of parameters should considered for proper vertical handover decision.

In [25], Phemina and Sendhilnathan, proposed a Mobility management in 4G wireless network using FL (fuzzy logic). The Algorithm used five input parameters which are "Received Signal Strength (RSS), BW, Monetary Cost, User Preference (UP) and UE Velocity (V)" while the output is the HO decision. The author noted that the higher the number of rules the better the convergence of the handover decision which means the more the input to the fuzzy inference to the system the better the handover decision. In vertical handover decision, many issues have to be optimized for performance improvement. Such problems are: overlay scenario with multi- criterion, which can easily be handled by soft computing techniques. In [26], Nasser proposed A HO scheme between a cellular mobile system and a WiMAX mobile system in physical layer mode for high data rates, high mobility and traffic congestion reduction. The algorithm considered traffic load, signal quality and mobile terminal (MT) with an assumption that there is perfect synchronization between the Cellular mobile system and WiMax system. [27] Proposed an inter-WiMax handover with initial ranging and periodic ranging. The initial ranging is to determine the transmit power of the MT to BS terminal and at the second ranging. A time alignment message is sent from eNB to UE as it moves around the radio coverage area.

The HO between WiMAX and UMTS system is given in [28]. The algorithm focused on the moving mobiles and performance evaluation is based on the packet lost rate of the intersystem HO between the two wireless networks UMTS and WiMAX. The performance as shown by the simulation results is satisfactory, but decreases with the increase in the mobile speed. In [29], Edward proposed a WiMAX /LTE HetNet HO algorithm. The author modeled a scheme called Session initiation protocol prior handover with cross-layer design using MIH service to reduce the session re-setup delay in a WiMAX/Long Term Evolution (LTE) HetNet. The work also reduced IP multimedia subsystem session re-setup by minimizing the number of SIP message exchange during vertical handover. THE proposed method was simulated on NS2 environment and the simulation result shows 18% improvement in comparison with former approaches during VHO between WiMAX and LTE.

In [30], the author proposed a vertical handover between the Wi-Max and WIFI Networks by changing the parametric

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changes while performing the base station selection. The algorithm depends on three parameters which are: load on the base station, distance and transmission time. The performance evaluation metrics used are effective throughput and delay.

In [31],the author proposed an Adaptive Handover Scheme which is based on velocity for Mobile WiMAX. It should be noted that the mobility of the mobile users is a critical and important factor as far as wireless communication is concerned. The threshold changes as the velocity increases to avoid unnecessary handover, delay and thereby optimising the resource utilization.In [32], a soft-handover was proposed. The algorithm selects a potential base station while relating handover latency with UE velocity. The algorithm performance was evaluated with metrics BER and transmission time of mobile WiMAX using BPSK, QPSK & 16QAM modulation techniques. The author noted that, seamless handover in mobile WiMAX is achievable with the algorithm when the mobile station travels at the speed of 20 m/s with dramatically low latency. However, achieving the mobility of up to 120 km/h while the latency is less than 50ms with an associated packet loss that is less than 1percenit is still a challenging issue.

In [33],the author proposed a Fuzzy Logic Based Self-Adaptive Handover Algorithm for Mobile WiMAX (FuzSAHO). The fuzzy logic deals with either the Handover should be initiated or not. The criteria used include the RSSI and MS velocity. The algorithm simulation results show that Ping-Pong and delay is reduced. "In comparison with RSSI based and mobility improved algorithms, FuSAHO reduces the number of handover by 12.5 and 7.5 %, respectively when the MS velocity is <17 m/s. In term of handover delay, the proposed algorithm shows an improvement of 27.8 and 8 % as compared to both conventional and MIHO algorithms, respectively" as a result the proposed FuzSAHO is better. Nevertheless, there is need to check the implication of high UE velocity on the algorithm performance.

There are many strategies for optimising handover in order to achieve a minimal handover delay. The authors in [34 - 38] focused on one of the strategies where small message is involved in handover execution in order to achieve faster handover. Another strategy is to make the scanning threshold adaptive as regards cell reselection phase, therefore, cell information of the neighbouring cell is necessary [39]. Authors in [39] used a technique that makes the UE to carry out pre-scanning before actual HO using fuzzy logic based movement prediction. Therefore, there is a resource reservation for potential HO at the TBS before the HO is initiated and execution. The third strategy has to do with efficient selection of HO decision. In [40], the author present logarithm function assisted for the mobility improved handover (MIHO) algorithm which is velocity based. The results confirmed the importance of UE velocity on HO algorithm efficiency. However, velocity alone is not sufficient to achieve a seamless HO. The author in [41] has suggested a fuzzy logic approach to enhance the eNB selection. No result was reported by the author [42]. Fuzzy logic has been used in the cellular network handover systems extensively, and it has proved efficient as it introduces a better handover performance than the conventional handover [43].

IV. CONCLUSION

We have presented the list of some methods been employed so far in the area of Mobile communication handover and It is worth noting that QoS in mobile communication is tied mostly to how fast and successful the handover is carried out. It is also noted that the soft computing based algorithm performed better due to the ability of the soft computing method to handle the uncertainty embedded in the mobile wireless communication network. Therefore, there is a need for more seamless handover by selecting multiple and appropriate network parameters.

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