VERTICAL HANDOVER DECISION MODELLING IN HETEROGENEOUS WIRELESS NETWORK

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***Abstract*- The evolution of the next-generation wireless network has led to the increasing demand for handheld devices to enjoy mobility through "Always Best Connected" services. In the next-generation wireless network, seamless best-possible access to a network, which has a widely varying set of network characteristics, requires rigorous mobility management. The vertical handover facilitates users to roam across different networks with the seamless network connection. The vertical handover process that supports mobility can be initiated as mobile controlled handoff or as a network-controlled handoff process. Associating the user with a suitable wireless network using a vertical handover process through wide network integration is a challenging and difficult problem that has drawn the attention of many researchers.**

***Keywords*: Handoff, Mobility, QoS,**

I. INTRODUCTION

Basically, the process of handover is associated with the cellular network and its corresponding communication system and is defined as a transferring mechanism of ongoing data/services from one channel to another channel [1] [2]. The similar forms of handover process could happen both in cellular network as well as satellite communication system too [3] [4] in order to ensure seamless exchange of data or service. In Figure 1, it can be seen that there is a multiple forms of access points that are connected to the core network. These access points could be of same type of or different type too.

The importance of handover mechanism cannot be ignored in modern-days telecommunication system [5]. The first importance of handover process is its extensibility of the network by ensuring that there should be no call drop when a mobile user (on call) is migrating from one network region to another [6]. The second importance of the handover process is that it can divert the traffic from bottleneck region to idle region and thereby utilizes the channel capacity in more efficient way. It is because of the reason that there are good possibilities of overlapping of signals of mobile users if they are present in massive number in one cell. Hence in such condition, handover process can transfer the communication to different cell and thereby make good utilization of the channel capacity of the cell [7].

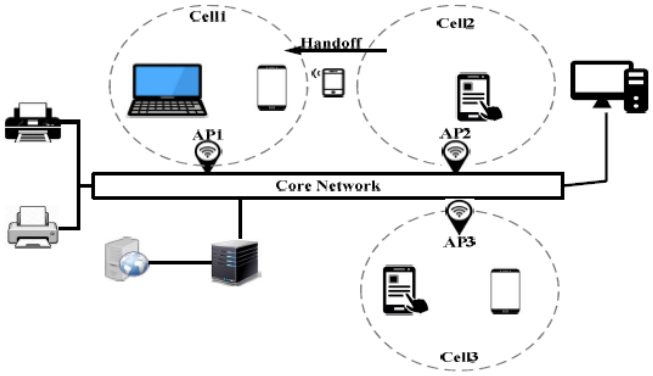

Figure 1 Typical Handover Mechanism

The third importance of the handover mechanism is its capability to resisting interfering channels especially in non-CDMA (Code Division Multiple Access) network. Under normal circumstances, there is a good possibility that communication channel could be highly subjected to interference when they are found to be utilized by different mobile user over same communication channel (located in different cell). In such condition, the call is transferred to a different channel that could be present on different cellular region or either within the same cellular region itself [8]. The fourth importance of the handover mechanism is the proper utilization of the frequency for dynamic behaviour of the mobile users especially for non-CDMA networks. Normally, in such forms of network, there is a sudden transfer of call from mobile user who stops suddenly from fast velocity of movement to smaller macro cells. This is done for the purpose of freeing some channel capacity that has positive effect over interference mitigation with respect to different users [9]. Therefore, handover mechanism can mitigate the near-far effect thereby solving the potential interference problems [10].

The current cellular region is called source while the new cellular region is called the target. There is a good possibility that source and target cellular region may be residing over different place or even in a same place also called as sectors [11]. The process of handover carried out between source cell and target cell although they are residing over same cells is called as intercell handover

[12]. There is an explicit case called as intra-cell handover where target and source could be a single cell with change in the communication channel [12]. The inter-cell handover supports seamless call relaying service while intra-cell handover supports mitigating interference / fading problems over communication channel by switching to better channel from error-prone channel.

II. RELATED WORK

In Multi-Radio Multi-Channel (MRMC) Wireless Mesh Networks (WMN), the numbers of available frequency channels non-overlapping and the numbers of channels are fixed. The busy and idle periods of the channels are monitored passively by estimating the bandwidth of the wireless networks. Node failures and mobility of the nodes are detected by using an efficient channel assignment protocol. The performance of the network is improved by a cross layer design. The cross layer design includes tightly coupled and loosely coupled cross layer designs. Information such as transmission count of data packets and packet delivery ratio are used for predicting link capacity called as Effective Link Capacity (ELC). Partially Overlapped Channels (POCs) are proposed for improvement in network capacity and interference rejection.

An efficient Medium Access Control (MAC) protocol is required to eliminate collisions during transmission and to improve network performance in multi radio multi gateway wireless mesh network a joint routing and channel assignment scheme is proposed for improving the communication quality of wireless networks.

Parameswaran, et al. (2014), proposed a method in mobile ad-hoc networks, where it is an on-demand multipath routing algorithm given for video transmission applications a number of multipath routing protocols can be extended from a single path AODV routing protocol. The main advantages of multipath routing protocols include avoiding unnecessary routing packets and reduction in route establishment delay. But this fail to address the issues energy management and pocket delivery loss

McNair et al. (2004), provide a mechanism for Vertical Handover in which the user maintains connection when switching from one WAN to another WAN technology (e.g.), from WLAN to UMTS and vice versa. This focus only on the upward handoff but the handover management demands both upward and downward handover within the heterogeneous wireless network

Lee et al., (2009) have detailed VHO as different from conventional horizontal handover. In VHO, a session is seamlessly handed over to a new WAN in an interoperable region based on a criterion which evaluates the signal quality. Here have not encounter the issue of mobile velocity when mobile terminal moves with slightly higher velocity need more precious algorithm

Sudipta Patowary et al., (2010) says that, the handover management procedures remain a widely studied issue in the case of heterogeneous network environment. MTs should be able to move among these heterogeneous networks in a seamless manner. Various activities of working groups such as IEEE 802.21 (I. 802.21, 2006) are currently under way. They have given the study report based on the SINR.

Perkinset et al., (1997) have suggested IETF MIP or 3GPP standards. IEEE 802.21 supports a Mobile-Controlled Handover (MCHO) scheme with MIP as its mobility management protocol. The details of network selection entity and the specification of handover policies that control handovers are outside the scope of the 802.21.

Wang et al., (1999) have proposed the objective of a VHO strategy as to guarantee QoS for a variety of applications. In general, the strategy can perform a complex decision that combines large number of (QoS) metrics.

The first VHO decision scheme, considered multiple criteria policies it introduced a cost function to select the best available WAN based on three policy parameters (bandwidth, power consumption, and cost). Suggestion for selecting route for access new mobile terminal is not provided.

Zhu et al. (2006) describe the multiservice VHO decision algorithm based on cost function. However, context-aware decision solution has been inspired for huge efficiency and taking into account more criteria, proof-of concept, has been provided based on the ability of a user or network to choose among different network types. While extending this for more complex situation QoS normalisation is still an open issue.

Ahmed et al., (2006) have designed a cross-layer architecture providing context-awareness, smart handover, and mobility control in a W-WAN to WLAN environment. They have proposed a VHO decision, with a cost function-based solution, taking into account network characteristics and higher level parameters from transport and application layers. For making faster handoff the transport layer parameters need to get in advance are not addressed.

Chan et al., (2002) have investigated the concept of Fuzzy Logic (FL). They have employed decision criteria such as user preferences, link quality, cost, or QoS. Upon a literature review, mobility prediction schemes in handover procedure have been found to be very critical in the handover performance.

Pollini et al., (1996) have investigated the handover procedure which is typically based on the received RSS from the base station. There exist several models, schemes and algorithms for handover procedure based on the RSS methods that are regularly based on hysteresis and threshold methods. This investigation have not given clear idea about the SINR detection which important for making faster handover

Taniuchi et al., (2009) suggested comprehensive methodology for mobility-prediction based VHO scheme. In this respect, the proposed VHO algorithm considers the received SINR as its handover criterion. Moreover, the handover process is split into a number of phases. Handover initiation decision which involves the decision to which point of attachment to execute the handover and its timing. Next is the radio link transfer, which is the task of establishing links to the new point of attachment. This phase is based on the estimates of a number of significant QoS metrics that are meant to satisfy the basic requirements of a variety of applications.

The study by Gin-Xian Kok et al., (2013) shows the network interface queues are monitored and the channel conditions estimated by the nodes to distribute the data packets to different available channels and next hops. In the extended protocol, the data packets consist of piggybacking channel condition information. The estimated channel condition at a particular node is propagated to the neighboring nodes in the network by using this information.

An efficient and dynamic routing protocol is designed for configuring the network. The choice of a routing protocol has a great impact on the performance of the entire network. In the reactive routing protocol, the routes are created only when there is a need for transmission of data. The communication among the mobile nodes is based upon the routing protocols.
The performance of the network is affected by the performance of the routing protocols. The ad hoc on-demand multipath routing protocol called Link Reliable Multipath Routing (LRMR) protocol is proposed in order to avoid route breaks and link failures.
A Decision making algorithm based on RSS research system has introduced Cognitive Agent VHO which is an effective and a knowledgeable network decision for vertical handover process. From the brief review of recent and novel development in heterogeneous wireless networks, the modern and smart of multiple technologies (GSM, UMTS, WLAN, LTE) form a heterogeneous wireless network. HWN intends to serve the end users balancing and seamless communication service to all types of information (audio, video, text, etc.). Heterogeneous wireless network is a major part of HetNet (Heterogeneous Network). HWN providing an effective and compatible network services to mobility nodes through different wireless networks access methods, while different inter and intra networking issues appear during the communication of users through roaming and handover scheme. HWN is a network which uses different wireless devices with different underlie of RAT (Radio Access Technology).
Amalichinnappan et al., (2015) investigated a multi attribute based VHO algorithm to mobility nodes and its characteristics. Here Access Point (AP) has a predetermined switch to the nearest adjacent AP, handover start trigger when the coverage area of signal rate of the AP is below a pre calculated threshold. The main drawback of this method is its applicability only for Wi-Fi and WLAN networks. Now a days Wireless Communications (WC) have HWN providing various ranges of coverage and Quality of Service (QoS). Different WC services are also available (like Wireless Mesh Network (WMN)). The wireless network infrastructure defines the mobility nodes to execute applications with discrete levels of bandwidth and different forms of connectivity of network based on the types of networks. In HWN major problems are mobility node, handover of different networks, interference with different channels and Quality of services and experiences.
Generally VHO network service provides concentrate on the types of networks, traffic, number of users, service difficulties and load balancing factors. The concentration is on RSS, service type, bandwidth and quality factors from receiver side.
Kantubukta et al., (2013) have detailed a Fuzzy-Top decision algorithm for QoS based energy aware decision making for the heterogeneous handover procedure. The results of the Fuzzy-Top algorithm are compared with the Markov Chain based VHO method by taking minimal numbers of QoS parameters and for better handover we need to address more factors along with energy.
Tamijetchelvy et al., (2012) have developed a novel handover method using self-selection decision tree for internet based handover. It can be used for next generation based heterogeneous handover purposes. The drawback of this model is, it is not suitable for non-internet based voice calls.
Alslaim et al., (2014) have indicated the need to develop a good solution for global connection with anytime-anywhere logic with high speed, reliable channels for communication. A Multi-Criteria VHO decision algorithm is proposed for heterogeneous wireless network communication with mobility.

III. PARAMETERS OF VHO

In the VHO process, the mobile terminal decides whether to continue with the current network or to switch over to the new network. This decision depends on a number of parameters known as network selection parameters.

Received Signal Strength (RSS)

Most HHO algorithms use RSS as the main network selection parameter. It is one of the most widely used handover criteria for horizontal handover since it is easy to measure and has a direct relation with QoS. RSS is considered as a good indicator of network signal strength and link quality. But RSS based handover is not a good solution for seamless handover since in heterogeneous environment, different networks have different values of channel coding, noise and power, which makes RSS incomparable for different RATs.

Network Connection or Handover Processing Time

It is the time span for which user terminal remains connected to a particular network. It is necessary to calculate this connection time in order to choose the perfect moment for triggering the handover, so as to maintain QoS and to decrease the number of network connection fails since handover done
too early can result in resource wastage, energy loss and done too late means can cause of handover failures.

Handover Latency

It is the duration between the last packets received from the old network and arrival of the first packet from target network. It is main factor affects the quality of service.

Bandwidth

Bandwidth refers to the speed of bit transmission in the channel in bits/sec, hence available bandwidth is a good indicator of traffic state and conditions in target network and become an essential factor in applications which are delay sensitive. Generally network with higher bandwidth rate is preferred for successful handover, probability of call dropping and call blocking are getting decreases with increase the available bandwidth rate (speed of bits transmission rate high). Bandwidth based Channel allocation plays a vital role in the wireless network mobile communication.

Power Consumption

Power becomes critical when the mobile terminal battery is low. In such a case, the network which may extend battery life is preferable for handover.

Cost
It defines the charging policy of a network. Different networks have different charging policies making it is necessary to consider the cost of a network service while making the handover decision.

Security
The network providing a high level of security is chosen for handover. For the applications demanding high confidentiality, availability and integrity of transmitted data.

Users Preferences
Users preferences based on application requirements like service type data, video, voice and quality of service may be taken into consideration while selecting the target network from among the available networks.

IV. RESULT ANALYSIS

This section discussed about the 3G to 4G Base station.
The challenges in the planning of cellular networks can be resolved, to a certain extent, by evaluating the coverage area and the handover points dynamically, under varying propagation conditions. Figure 3 captures the scenario with two base stations BS1 (3G) and BS2 (4G).
The operating frequency of 3G base station is 900 MHz and the operating frequency of 4G base station is 1800 MHz. Figure 4 captures the geometrical analysis of the movement of user. As shown in Fig. 3, the base station BS1 is positioned at point A and base station BS2 is positioned at point B. In this paper, the user trajectory is considered to be along straight line AB i.e. the user is moving

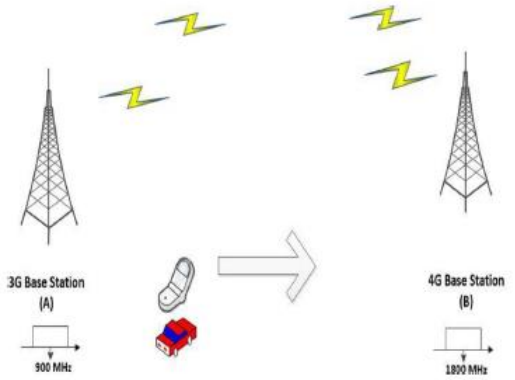

Fig. 3 User trajectory and coverage area

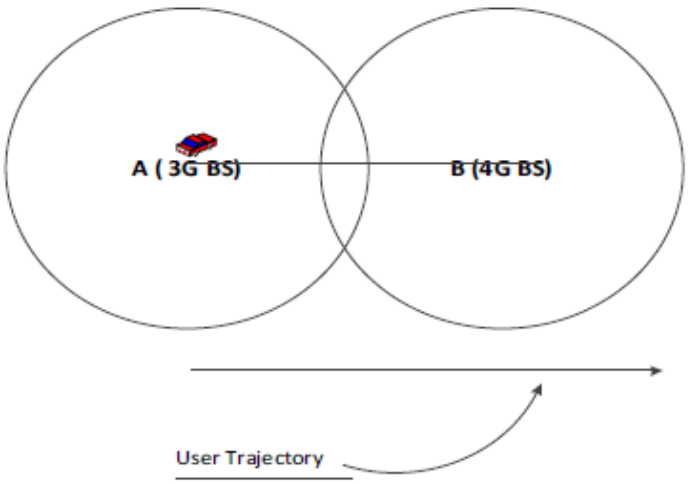

Fig. 4 Geometrical analysis of user trajectory

from point A to point B in a straight line. Figure 4 captures the coverage areas and the user trajectory along line AB. From Fig. 4, we analyze the user trajectory as following table

Table 5.2 Variation in the point of Handover for proposed scenario

3G base station with frequency	Point B—4G base station) with frequency	Handover point from A (3G base station) in mtrs
2100	2100	951
	2300	983
	2500	1016

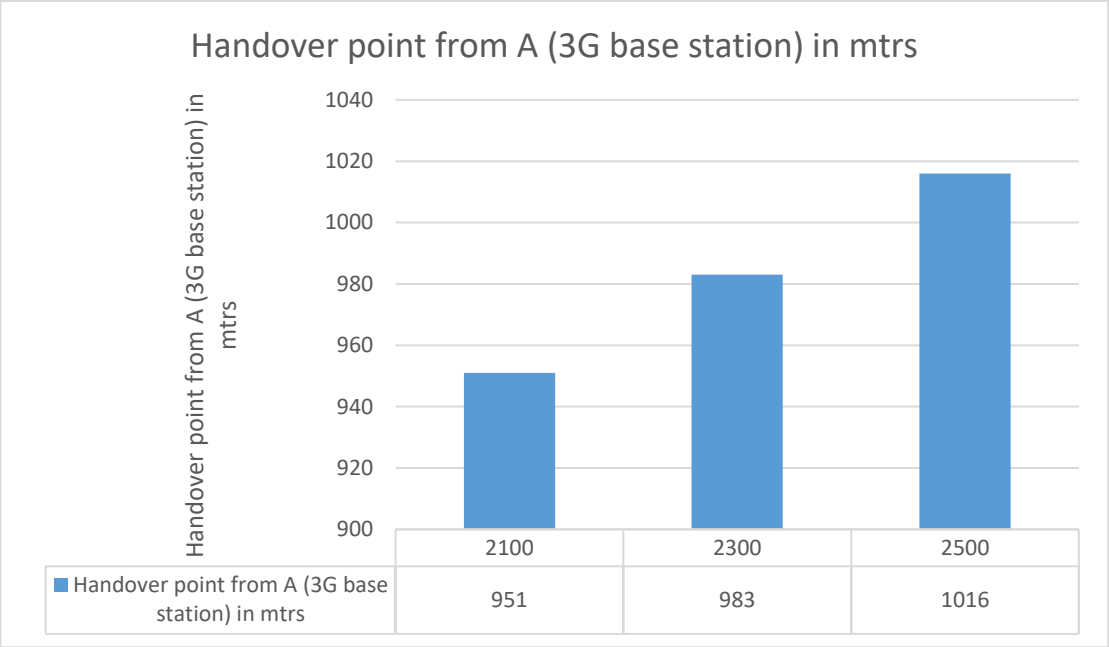

Fig 5 Variation in the point of Handover for proposed scenario

Variation in the point of Handover for proposed scenario for 2100 MHz Frequency is represented in fig 5. The handover point from 3G Base station is measured as 951, 983 and 1016 respectively.
In 4G Base Station for 2100 MHz, Handover is calculated at 951 meter. Similarly, 4G Base Station for 2100 MHz, 2500 MHz, and Handover is calculated at 983 meter and 1016 meters.

V. CONCLUSION

The proposed thesis work has presented a discussion about the significance of the handover technique in the heterogeneous wireless network. The theoretical study as well as existing approaches towards improving the performance of handover mechanism has been studied in the due course of identifying the research problem. After reviewing various existing approaches in the literature review, it is found that there are various unsolved issues associated with the handover mechanism system especially in vertical handover system. It was found that existing issues towards seamless mobility was not totally addressed and they were only symptomatic.
Researchers have used different forms of approaches and techniques towards ensuring there are reduced call drops during vertical handover system but they did that without considering heterogeneity among the networking and communication devices. Apart from this, it was also found that there are less emphasis to the faster processing and computation process, which is one of the essential performance parameter during vertical handover process. Apart from this, it was also found that there is quite a less memory management effectiveness in existing studies. Therefore, the major problem found in existing system was ineffective design of relaying services during vertical handover especially in heterogeneous networks.

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