Performance Improvement of Seamless Vertical Handover in Heterogeneous Wireless Network

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Abstract-- For the development of the wireless networks the design of seamless and efficient Vertical handovers is an essential issue. Next generation wireless communications will likely rely on integrated networks consisting of multiple wireless technologies. So the integration of Vertical handovers with other wireless technologies, such as WLAN, Wi-Fi, WiMAX, UMTS or 3G, has attracted research community for the last few years. With the recent introduction of mobility management frameworks in the IEEE 802.16e standard, the performance largely depends on the capability of performing fast and seamless handover between heterogeneous networks. Seamless vertical handover between different access technologies is a great challenge as it needs to obey different performance constraints. in this thesis we proposed a new algorithm that compare cost, performance with traditional Hasswa et al's algorithm and Omar's algorithm . Our new proposed approach provides better performance and more exhaustive for enhancing VHO.

Keywords-component; Vertical Handover (VHO), Radio Access Technology (RAT), Media Independent Handover (MIH).

I. INTRODUCTION

Wireless communication is one of the poplar media of communication. Mobile devices enabled with multiple wireless technologies make possible to maintain seamless connectivity in highly dynamic scenarios such as vehicular networks (VNs), switching from one wireless network to another by using vertical handover techniques (VHO).

The next generation of the wireless networks will consist of several overlapping tiers. Provision of undisrupted communication to mobile users is a challenging task. Handover delay is one of the problematic issues that users are faced in the heterogeneous networks. However, in the case the heterogeneous wireless systems such as Wireless Fidelity (WiFi), Universal Mobile Telecommunications System (UMTS), Worldwide Interoperability for Microwave Access (WiMAX) and Long Term Evolution (LTE) will coexist providing mobile user with roaming capability across different networks. To fulfill these requirements of seamless Vertical handover (VHO) two mechanisms were produced independently by IEEE and 3GPP namely Media Independent Handover (MIH) and Access Network Discovery and Selection Function (ANDSF), respectively. Each of them enables a seamless VHO between the different types of technologies such as, UMTS, WLAN, WiMAX, WiFi, GPRS and LTE.

However there is inconsistency in its operation in the traditional algorithms, hence it needs some improvements. In this paper we propose a new approach to improve VHO in heterogeneous networks environment by using a new algorithm approach, which new algorithm can enhance performance by reducing cost and time. The results of the simulation of those algorithm show that the proposed algorithm has better performance than traditional algorithm.

The rest of the paper organized as follows: section II presents Vertical Handover, in section III analysis of VHO algorithms, in section IV presents Our proposed algorithm, in section V presents simulation results and discussion and finally conclusion and future work in section VI.

II. VERTICAL HANDOVER

In cellular telecommunications, the term handover or Handoff refers to the process of transferring an ongoing call or data session from one channel connected to the core network to another.

A. Classification of Handover:

Horizontal Handover: A horizontal handover or intra-system handover takes place between PoA supporting the same network technology, e.g., two geographically neighboring BSs of a 3G cellular network.

Vertical Handover: Vertical handover or vertical handoff refers to a network node changing the type of connectivity it uses to access a supporting infrastructure, usually to support node mobility. For example, a suitably equipped laptop might be able to use both a high speed wireless LAN and a cellular technology for Internet access.

B. Network Parameters:

Several parameters as given bellow, proposed in the research literature for use in the VHD algorithms. We briefly explain each of them below.

Received signal strength (RSS**):** RSS is the most widely used criterion because it is easy to measure and is directly relevant to the service quality. There is a close relationship between the RSS readings and the distance between the mobile terminal and its point of attachment. The majority of existing horizontal handover algorithms use RSS as the main decision criterion, and RSS is an important criterion for VHD algorithms.

Handover latency: Handover latency is defined for a MT as the time that elapses between the packets received via the old access router and the arrival of the first packet

along the new access router after a handover. Handover latency can be considerably different between various technologies and this has a major impact on interactive applications. Available bandwidth is a measure of available data communication resources expressed in bit/s. It is a good indicator of the traffic conditions in the access network.

Security: Security For some applications, confidentiality or integrity of the transmitted data can be critical. For this reason, a network with higher security level may be chosen over another one which would provide lower level of data security.

C. Vertical Handover Procedure

The handover is a mechanism which allows the mobile users to continue their ongoing sessions when moving within the same *RAT* coverage areas or traversing different *RATs*, named Horizontal Handover *(HHO)* and *VHO*, respectively. In the literature most of the research papers divide *VHO* into three phases; Collecting Information, Decision and Execution as described below.

Handover Collecting Information: In this Phase, all the required information for *VHO* decision is gathered. Some of criteria related with the user preferences (such as cost, security), network (such as latency, coverage) and terminal (such as battery, velocity).

Handover Decision: In this Phase, select the best *RAT* based on aforementioned information and informs the handover execution about that.

Handover Execution: In this Phase, the active session for the user will be maintained and continued on the new *RAT* after that the resources of old *RAT* is released eventually.

III. RELETED WORK

There are many researches which have been conducted recently about the integration of RATs to enhance the VHO procedure [3, 8, 9]and [1]. In [8], new logical entity was introduced in target network named Forward Authentication Function (FAF) for two reasons, First, to enable the transmission form WiMAX to 3GPP (Authentication), Second, to avoid direct link between 3GPP and WiMAX, i.e., "avoid the WiMAX access scheduling measurement opportunities to the UE in order to measure neighbor 3GPP sites". This approach does not consider two vital things in the VHO procedure, First, the source network is not informed by User Equipment (UE) about it's moving to the target network which results in Packet losses. Second, it lacks a releasing procedure for the resources already in use in the network.

In [9], new logical entity was introduced named Data Forwarding Function (DFF) to solve the problems that were raised in [8].

In [3], it was demonstrates that due to the combination between MIH and NADSF there is no need for FAF and DFF to be exist, beside, the UE obtains operator's policies from the ANDSF which has the role of selecting the target network.

In [1], proposed an improved algorithm without combining MIH and NADSF that can provide better performance, less complexity and more exhaustive compared to the approach [3].

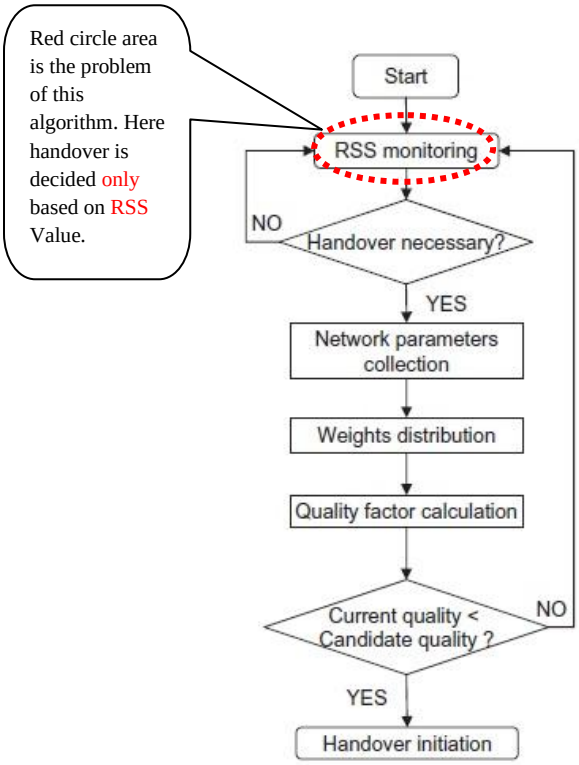

Figure 1: Hasswa et al.'s VHD heuristic algorithm

IV. PROPOSED ALGORITHM

Our proposed algorithm is based on Omar's seamless vertical handover algorithm. It take a VHO call and perform operation on that call and take handover decision. If not possible the handover it reject the call.

We describe our Procedure through the VHO phases. They are Initiation, decision and execution. Three VHO scenarios are considered to be in the source network and destination network: UMTS to Wi-Fi, Wi-Fi to WiMAX and WiMAX to UMTS.

Initiation Phase: In this phase, the node will search all network and initial the value all network parameters. And also set the minimum user criteria. VHO will trigger imperatively e.g. RSS or/and alternatively based on the user preferences such as low cost, low latency, high data-rate, high security etc.

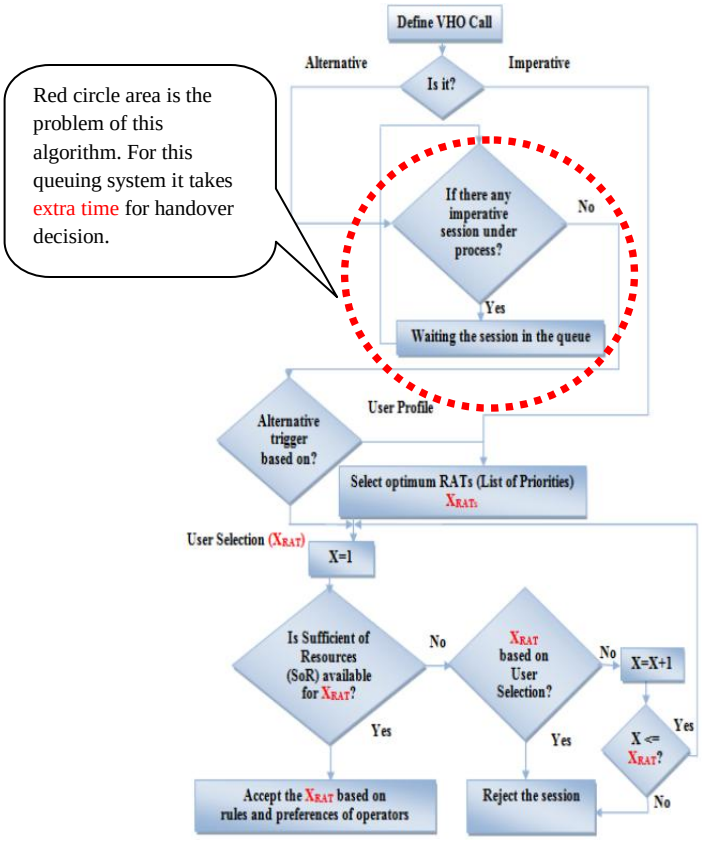

Figure 2: Omar et al. Algorithm

Execution Phase: In this phase, The UE will be received optimum RAT to start its authentication with the target network and obtain CoA from DHCP. After that update/Acknowledge binding message notifies Home Agent (HA) about new CoA to starting send/receive data buffering and continuing the session within target network. Finally, after the completion of sending the buffered data the resources is released by MIH.

Algorithm (Proposed):

Step-1. Search all network and initial all network parameters (RSS, Cost, Latency, Datarate, and Security). And set the min_rss, max_cost, max_latency, min_datarate, min_security;
Step-2. Check the current rss value if rss value is less than min_rss value go to Step-5
Step-3. Check user criteria (Cost, Latency, Datarate, Security) if any of them is in satisfactory level than go to step-8.
Step-4. Invalid Call go to Step-12.
Step-5. Compare user criteria between RATs except existing RAT.
Step-6. If sufficient of resource (SoR) available go to step-11.
Step-7. No change of RAT goes to step-12.
Step-8. Compare all user (Cost, Latency, Data rate, Security) criteria of all RATs.
Step-9. If sufficient of resource (SoR) available go to step-11
Step-10. No change of RAT goes to step-12.
Step-11. Select the satisfied RAT.
Step-12. Reject the session.

Algorithm Flowchart:

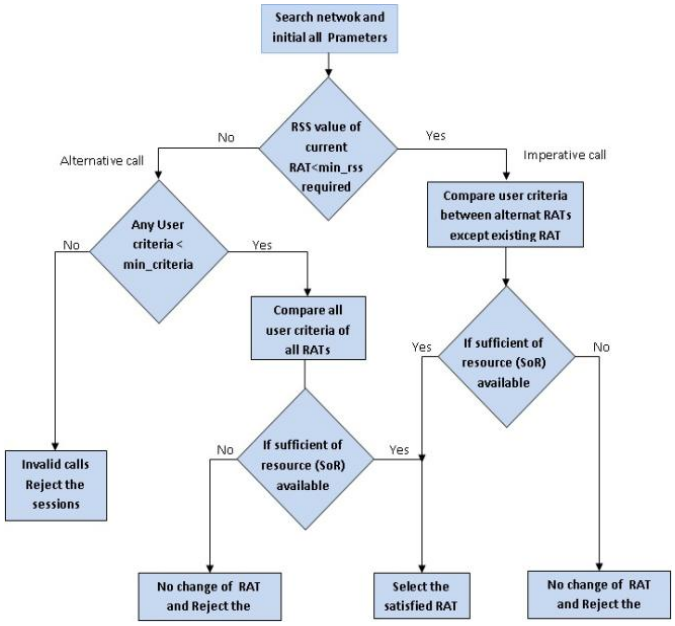

Figure 3: Proposed Algorithm Flowchart.

V. SIMULATION RESULT

In table I, we compared the success rate of three algorithms with total number of calls are 12. Here, it is shown that the Improved algorithm [1] and our proposed algorithm have the same success rate. Figure 4 also represents the success rate of our proposed algorithm with two other algorithms.

In table II, it is shown the average time comparison success call probabilities. Here clearly define that our proposed algorithm has better performance compared with other two algorithms.

Table 1
Success Rate Comparison of Tree Algorithms

Algorithm	Total Call	Success	Rate
Hasswa et al.	12	2	16.66 %
Omar el al(Improve Algorithm)	12	7	58 %
Proposed	12	7	58 %

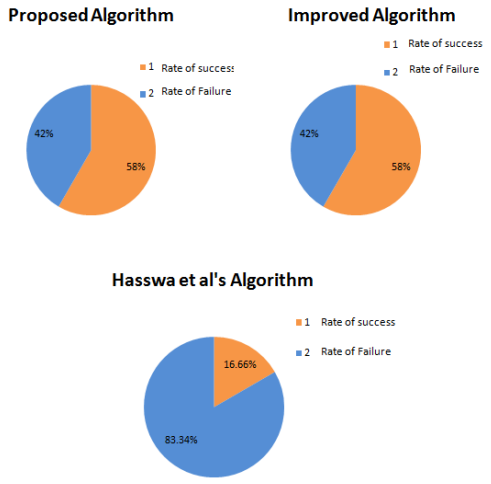

Figure 4: Comparison of success rate of three algorithms using pi-chart.

Table 2
Time comparison of three algorithms.

Algorithm	Total Time	Success Call	Average time
Hasswa et al.	14	2	7
Omar et al	153	7	21.85
Proposed	93	7	17.14

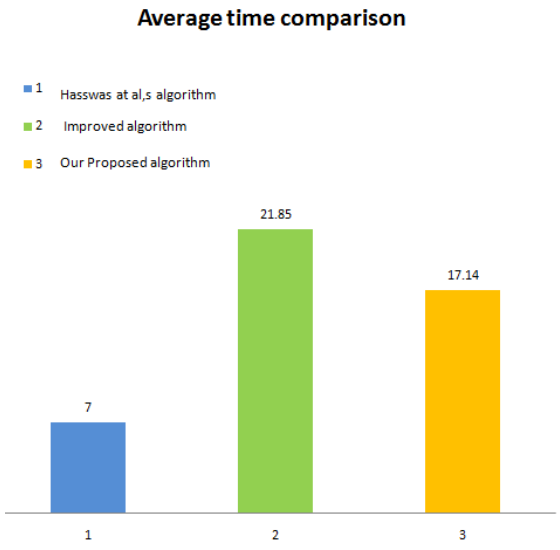

Figure 5: Average time Comparison of three Algorithms.

VI. Conclusion

The vertical handoff will remain an essential component for wireless networks due to switching of mobile users amongst heterogeneous networks. Our proposed VHO approach have better performance, less complexity, reduce time and more exhaustive for enhancing VHO procedure. Our proposed algorithm compared with two algorithms one is Hasswa et al.[2] algorithm and another one is Omar et al. algorithm [1].Our proposed VHO procedure primarily based on MIH to execute it as depicted in Figure 3. However it introduced the definition of VHO type and giving priority to imperative sessions over alternative sessions. Also it achieves less failure of connection due to using the optimum RATs as depicted in Figure3. However, it is difficult to consider all the parameters during designing the decision model for VHO but if we consider more parameters, the outcome of the decision mechanism would definitely improve.

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