Performance study of SINR scheme for Vertical Handoff in wireless networks

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Abstract —**Signal to Interference and Noise Ratio (SINR) may not be the best scheme for selecting the service access point or base station. Although this SINR-based scheme has higher system throughput and low disconnection probability as compared with other vertical handoff schemes. In this paper we study the performance of SINR scheme and motivate the probability of using other distance based schemes instead. The simulation experiments show that in mean about 9% of users calls are dropped in WLAN and WCDMA network.**

Keywords-component*; SINR; vertical handoff ; WLAN; WCDMA*

I. INTRODUCTION

These days the rapid development of the telecommunication and Internet leads to a wide spreading of multiple heterogeneous wireless technologies and to developing devices that are more capable, the mobile communications carried out through highly heterogeneous wireless networks that provide varying coverage area and varying Quality-of-Service (QoS). A heterogeneous wireless network is a network that has different access technologies (radio interfaces), different network architectures and different protocols to connect mobile users with other devices and to be accountable administration for routing and mobility issues between mobile users. Increasing mobile users demand for access to mobile communication services is accelerating the technological development towards the integration into the various modes of wireless access communications [1]. Nowadays, mobile users demand to be connected with the Internet while they move freely, and Always Best Connected (ABC) has become a very important service for mobile users to get high quality services with high data rates [2]. This issue demands to integrate a variety of heterogeneous wireless networks to form one virtual homogeneous wireless network. This integration needs to take care of the differences in network architecture, protocols and access technologies. Moreover, the integration should take into account the user mobility from one access point to another.
For example, the Fourth Generation (4G) wireless network is composed of a variety of different wireless networks that are complementary to each other [3]. Thus, the integration will allow a mobile users to be able to choose the most appropriate access network among the available alternatives (these include IEEE 802.11 Wireless Local Area Network (WLAN) and IEEE 802.16 Worldwide interoperability for Microwave Access (WiMAX)), in addition to the traditional cellular networks which are almost commonly accessible today.

One of the important issues in the mobility fields is the mobility management. This is concerned with two main issues; the location management and the handoff management. The location management enables the system of tracking the locations of mobile users continuously when it moves from one location to another; this might be in the same system or in a different one. On the other hand, the handoff management is a fundamental operation for any wireless network that aims to preserve active connections with high communication quality between the network and mobile user during the movement. This process requires keeping track of the mobile user's state, either when it is linked with an active connection [4] or when it is moving from one cell to another [5].

Mobile user must be able to seamlessly handoff to the approximately best connection among all available candidates based on some metrics that ensure there was no interruption will be happen to any ongoing connection. Such ability to handoff between heterogeneous networks is referred to as seamless vertical handoffs [1]. As an important step towards achieving this objective is the emerging IEEE 802.21 standard, which provides a framework to support protocols for enabling seamless vertical handoffs [1]. IEEE 802.21 only provides the overall framework specifications, the actual implementations of the algorithms are left to the designers. Several vertical handoff schemes have been proposed in the research literature [6] [7].

II. MOTIVATION AND PROBLEM STATEMENT

The next 4G wireless networks is a convergence of a variety of different wireless networks providing the mobile user with the best anywhere and anytime connection in addition to improving the system resource utilization. Moreover, with the advent of the Internet, mobile user want to communicate with the best connection network of all available networks in order to run his applications without any interruptions. However, when a mobile user changes his location the best connection may be broken and therefore a vertical handoff is initiated to another available connection that takeover the connection without having to restart the running applications.

The radio wave propagation models [8] [9] can use this metric as a main parameter, to propose reactive vertical handoff scheme, where it is able to enhance and provides higher overall system performance compared with the SINR based vertical handoff scheme.

III. The SINR-based Scheme for Vertical Handoff in Heterogeneous Wireless Networks

The received signal strength Ɣ that is received at mobile user i when associated with WCDMA base station j [26] [34] can be represented as:

$$Ɣ_{BSj,i} = G_{BS} \; P_{BS} / (P_B + \; \Sigma (G_{BS} P_{BS}) - G_{BS} \; P_{BS})$$

Where:
GBS: is the channel gain power between mobile user i and BSj.
PBS: is transmitting power of BSj.
PB: is the background noise power at mobile user receiver end.

The received signal strength Ɣ that is received at mobile user i when associated with WLAN access point j [26] [34] can be represented as follows:

$$Ɣ_{AP\,j\,,\,i} = G_{AP} \; P_{AP} / (P_B + \; \Sigma \; (G_{AP} \; P_{AP}))$$

Where:
GAP: is the channel gain power between mobile user i and APj.
PAP: is transmitting power of APi.
PB: is the background noise power at mobile user receiver end.

In SINR scheme, Shannon's capacity formula is applied, where the value of received signal strength Ɣ represents the received signal strength at the mobile user. Therefore, we can use the Shannon's capacity formula, which is used to calculate the throughput in SINR, as follows:

$$R = W \log_2 (1 + Ɣ / \Gamma)$$

Where:
R: is the channel capacity (throughput) in bits per second.
W: is the bandwidth of the channel in hertz .
Ɣ: is the total received signal power.
Γ: is the total noise or interference power over the bandwidth, measured in watt or volt.

IV. RESULTS

The simulation result presented in Fig. 1 illustrates the mean value of dropped mobile users for SINR scheme in WCDMA network. From this figure we can show that as the number of mobile users increases in SINR scheme, the mean value of dropped mobile users becomes decreases from 17 until it reaches to 4 when the number of mobile users becomes 300 mobile stations. The reason is that the equation that we have adopted in the SINR scheme takes into account the channel gain power between each mobile user and its base station.

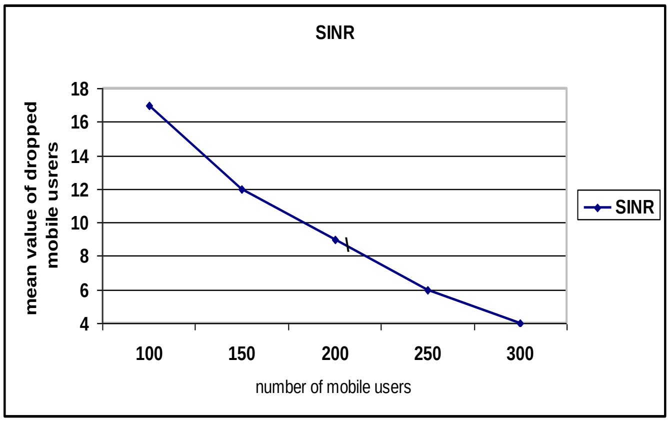

Figure 1: The mean value of dropped mobile users with different number of mobile stations for WCDMA network in SINR scheme

Fig. 2 illustrates the mean value of dropped mobile users for SINR scheme in WCDMA network. From this Figure, we can show that as the number of base stations in SINR scheme increases, the mean value of dropped mobile users becomes decreases from 14 until it reaches to 7 when the number of base stations becomes 9 base stations. This is because the SINR scheme influenced by a number of base stations in a positive ratio, so when the number of base stations increased, the percentage of signal strength to noise ratio be higher.

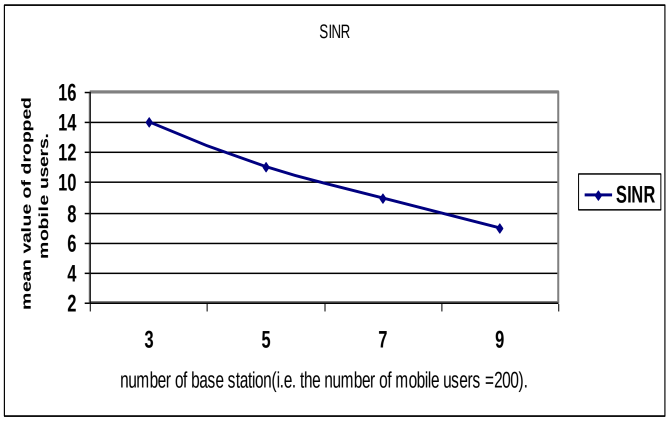

Figure 2: The mean value of dropped mobile users with different number of base stations for WCDMA network in SINR scheme

The simulation result presented in Fig. 3 illustrates the mean value of dropped mobile users for SINR scheme in WLAN. From this Figure we can show that as the number of mobile users increases in SINR scheme, the mean value of dropped mobile users decreases from 18 until it reaches to 4 when the number of mobile users becomes 300 mobile stations. The reason behind decreasing the number of dropped mobile users is that the decreasing in the number of access points could leads to reduce the interference that may affect on the mobile users, and thereby increase the signal strength and then decrease the number of dropped users, see equation 3.3.

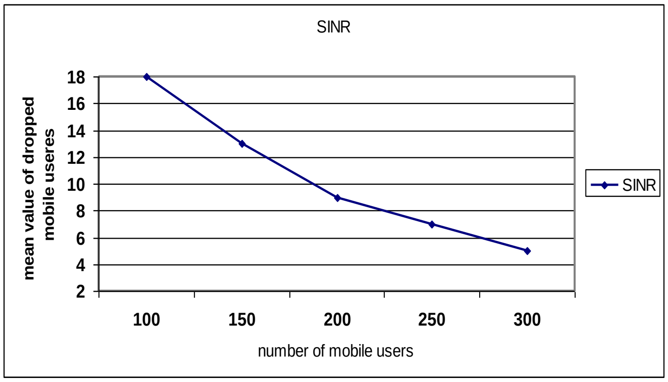

Figure 3: The mean value of dropped mobile users with different number of mobile stations for WLAN in SINR scheme

Fig. 4 illustrates the mean value of dropped mobile users for SINR scheme in WLAN. From this Figure, we can show that as the number of base stations increases in SINR scheme, the mean value of dropped mobile users decreases from 14 until it reaches to 8 when the number of base stations becomes 9 base stations.

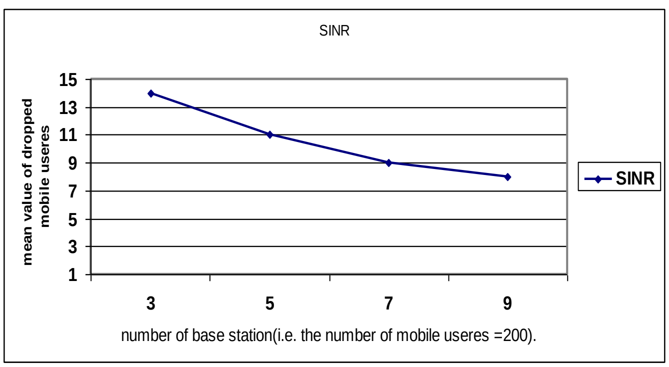

Figure 4: The mean value of dropped mobile users with different number of base stations for WLAN in SINR scheme

We suggest that using a reactive vertical handoff scheme, where it is able to consistently offer the end user with maximum available throughput during vertical handoff, would be a better choice. Also, we think it will enhance and provides higher overall system performance in terms of decreasing service disconnection probability and enhancing system throughput compared with the SINR based vertical handoff scheme. We still need a scheme that can enhance system performance in terms of decreasing service disconnection probability and enhancing system throughput. Thus, we presume that the distance is a better metric for decreasing service disconnection probability and enhancing system throughput through selecting the best AP or BS.

V. CONCLUSION

In this paper, we presented the design and simulation results of SINR scheme for vertical handoff in heterogeneous wireless networks and provide performance measurements using the MATLAB.

Also, we presented the general idea for our new scheme which based on the distance to select best access point or base station. As a future work, we want to propose a new system model for this new scheme and we will show that the distance is a better metric for decreasing service disconnection probability and increasing system throughput when selecting the best AP or BS. It is to enhance and provides higher overall system performance in terms of minimizing service disconnection probability during vertical handoff as compared with the SINR based vertical handoff scheme. The simulation experiments show that our proposed scheme, DSVH, significantly outperform the SINR scheme in terms of reducing the number of dropped users, and enhances system throughput.

VI. REFERENCES

[1] Xiaohuan Y, Y.Ahmet S, Sathya N. a survey of vertical handover decision algorithms in fourth generation heterogeneous wireless networks. The International Journal of Computer and Telecommunications Networking; 2010; 54(11): 1848-1863.

[2] Eva G, Annika J. always best connected. IEEE Wireless Communications; 2003; 10(1): 49 – 55.

[3] Enrique S, Yuxia L, Vincent W. an MDP-based vertical handoff decision algorithm for heterogeneous wireless networks. In Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC 2007); 2007 March; 57(2): 1243 – 1254.

[4] Hossen A. vertical handover scheme for next generation mobile networks. [dissertation]. Faculty of Engineering at AL-Mergib University; 2007 May.

[5] George L, Alexandros K, Nikos P, Lazaros M. handover management architectures in integrated WLAN/cellular networks. Communications Surveys and Tutorials, IEEE Communications Society; 2005; 7(4): 30–44.

[6] Janis M, Fang Z. vertical handoffs in fourth-generation multinetwork environments. IEEE Wireless Communications; 2004; 11(3): 8–15.

[7] Enrique S-N, Vincent W. comparison between vertical handoff decision algorithms for heterogeneous wireless networks. In Proceedings of the 63rd Vehicular Technology Conference (VTC'06), Melbourne, Australia; 2006 May: 947–951.

[8] Kemeng Y, Iqbal G, Bin Q, Laurence D. combined SINR based vertical handoff algorithm for next generation heterogeneous wireless networks. In Proceedings of the 2007 IEEE Global Telecommunications Conference (GLOBECOM '07), Washington, DC, USA; 2007 November: 4483 – 4487.

[9] Ayyappan K, Dananjayan P, Narasimman K. SINR based vertical handoff scheme for QoS in heterogeneous wireless networks. In Proceedings of the 2009 International Conference on Future Computer and Communication, IEEE Communications Society; 2009 April: 117 – 121.