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Vertical Handover in Wireless Heterogeneous Network: A Review

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Abstract: ***Seamless handover is one of the major requirements for the mobile terminal between heterogeneous networks. The wireless communications are increasing day by day through whole world due to cellular and broadband technology. Everyone around the world would like to be connected seamlessly anytime anywhere through the best network. Basically, Handover means transferring of a call from one network to another without disconnection. If we do not have handover then user's out going call will get disconnected whenever leaves the area of the parent cell. There are two ways handover can be performed; Vertical Handover (VHO) and Horizontal Handover (HHO). In the VHO user uses different access technology to switch from one cell to another whereas the HHO occurs between same accesses technologies. Example of VHO is handover between WLAN and cellular network. VHO decision is one of the necessary components of the fourth generation. This paper, gives the comprehensive study of VHO algorithm. We have discussed RSS based VHO algorithm, an adaptive lifetimes based VHO that handover between 3G networks and WLAN by combining the RSS with estimated lifetimes to decide the handover and travelling distance prediction algorithm that can works for WLAN to cellular network and vice-versa.***

Keywords: ***Handover; Types of Handover; WLAN; Vertical Handover Algorithm RSS.***

I. INTRODUCTION

Today in the modern generation communication systems where the network is provide seamless connections in terms of mobility. Mobility plays an important role in the fourth Generation wireless network when a user continues its call even when switching from one network to another then handover mechanism is used. Handover is basically transferring of call from one cell to another without disconnecting the current (ongoing) call. If there is no handover the current call is disconnected when we leave the noticeable cell area. Handover is needed for the mobile terminals among heterogeneous network. A suitable prepared device (such as laptop) is able to use both the High speed wireless LAN and cellular technology. In the present paper we give in Section II –Handover classification (Techniques). Section III –gives the concept of Wireless Local Area Network (WLAN) Section IV – contain the idea of VHO Parameters and Section V - contains VHO algorithms. In the end conclusion of this paper.

II. HANDOVER TECHNIQUES

According to network connections there are two types of Handover techniques as:

A. Horizontal Handover

Horizontal handover is a symmetric process that occurs in the same access technology or a device that change/handover the cells within the same network technology to maintain its continuity as shown in Figure1.Horizontal Handover can further be divided as: Link Layer Handoff and Intra system Handover. Link Layer Handoff means that, the Handoff between the two base stations of same foreign agent and Intra System Handover is defined as Handoff occur between two base station that belongs to different foreign and both the foreign agent have same system and same Gateway of agent.

B. Vertical Handover

Vertical handover is an asymmetric process that occurs between different base stations belong to different network.
VHO is also known as inter system handoff. There are three phases of Handover process is given as:

1. Handover information gathering-In the first stage, all the information is collected which is required for handoff.
2. Handover Decision-Here we use an algorithm to determine when and where to make the handoff process.
3. Handover Execution-In the last stage handover involve handover execution to change the channels corresponding to details required during the decision phase.

As we can see in the figure 1[1] show vertical and Horizontal Handover architecture. The heterogeneous networks combine the all benefits of each network to get better services in field of network capacity, coverage area and spectrum efficiency.

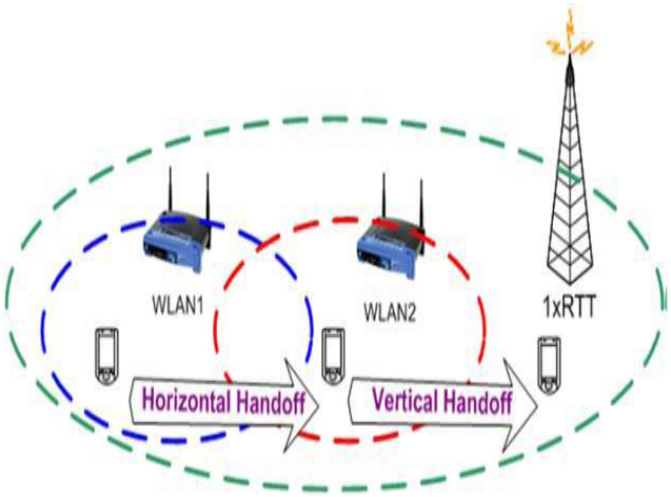

Figure 1 Vertical and Horizontal Handover

When the WLAN1 is switch to WLAN2 means handover is horizontal Handover between same access technologies and when the WLAN is switch to cellular network vertical handover occur between different access technologies. The Advantages of VHO over HHO are:

- In case of vertical Handover technique access technology is changed and in Horizontal technology is not changed.
- In vertical Handover multiple parameters and different IP address are used.
- We have to use more than single network connections are used in vertical handover technique whereas in horizontal handover single network connection is used.
- QoS parameter is changed in Vertical handover technique but in Horizontal it is not changed.
- Network interface may be changed in vertical handover.

There are two main scenarios in the Vertical handover that the mobile terminal represent moving into the Mobile in (MI) preferred network and Mobile out (MO) of the preferred network. In converged model, it is important to associate the mobile terminal with the preferred network as long as which satisfy the user application. By doing this we can improve the resource utilization and the customer perceived QoS.

III. WLAN

WLAN is the network that combines two or more device using a wireless distribution method. WLAN is defined as in which mobile user can communicate to LAN through radio/wireless connection. It spread or communicates with in a limited area (hotspot area) examples- school, home and office building etc. The user moves within a local coverage area and can be connected to a network. WLAN is also known as Local Area Wireless Network (LAWN) Wireless Local Area Network is an IEEE 802.11 standard, use ISM frequency band have ranges from 5.275-5.825GHz. The standard 802.11 is currently developed communication technology and operates on Media Access Control (MAC) and Physical Layer, there are three types of frequency band on which WLAN can operates. These are 802.11a, 802.11b and 802.11g, the IEEE 802.11a standard has data rate 54Mbps that operate in 5GHz frequency band. The 802.11b gives higher data rates and operate on 2.4GHz band and sometimes also called Wi-Fi IEEE standard 802.11g standard also operate both 2.4GHz band and data rates is of 54Mbps.802.11g supports CCK- OFDM standard in both 2.4GHz and 5GHz frequency band. Station called to Component that that transmit and received the radio signal with the devices receive transmitted signal can function as a router. Devices like laptop, IP phones connected to the WLAN and come under two categories are: Access points (APs) and Clients. Access Point function is computer, laptop computer, cell phones, and smart phones etc. serve as a client. All the station can communicate or transfer information to each other known as Basic Service Sets.BSS is divided in two field one is Independent BSS in which two client able to communicate without APs and not to other BSS such communication is called peer to peer WLAN. Second it communicates to other stations that use APs in other base station known as Infrastructure BSS. The WLAN provide less coverage area and high bandwidth but the cellular network provides wide coverage area and less bandwidth. Wireless LAN can better throughput, High bandwidth, security, high speed less cost and better performance than the cellular network.

IV. VERTICAL HANDOVER PARAMETERS

There are number of parameter used for making Vertical Handover decision. The figure 2 shows the parameters as

Received Signal Strength

RSS is defined as the distance between the mobile stations to the base station .RSS is the most important parameter as it is easily measured and directly related to quality of services.

There is a close relationship between the RSS readings and the distance from the mobile terminal to its point of attachment. [2]

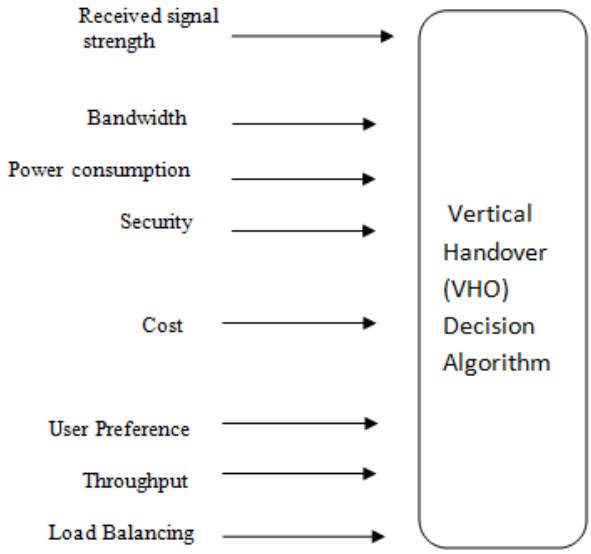

Figure 2 Parameter used for making VHO Decision

Bandwidth

The bandwidth is the difference between the upper range and lower range frequencies the measuring unit is in hertz (Hz). Higher the transmitted power lower the call dropping and call blocking probability, achieve higher throughput .The bandwidth is measured in bit/s.

Power consumption

Power consumption is also the necessary parameter when the mobile terminal battery is low. We have to find various methods to raise energy efficiency in wireless network.

Security

The application such as integrity of transmitted data can be decisive. Hence, network with high security may be chosen. In order to improve VHO techniques, it is necessary for incorporating robust security solutions in heterogeneous networks that would allow security anytime and in anywhere. [3]

Cost

Cost is one of the important parameter is taken into consideration in making vertical handover decision. We should Minimized the factor in Vertical handover technique. By Using the cost function parameter, we can examine both new call rate and handoff call rates.

User preference

The need for various applications such as Type of service, Quality of services may prefer different network.

Throughput

Throughput is defined as the average data rate of successfully delivered message. Network throughput is expressed in bits per second (bps) and is taken important parameter in dynamic metrics for making decision.

Load Balancing

Load balancing is necessary to balance the network avoid to become worse in service quality. As there is change in traffic loads, this will minimize traffic carrying capacity of the network. Therefore, network load should pay attention for getting best service and to raise/increase the high traffic carrying capacity.

V. VHO DECISION (VHD) ALGORITHMS

This section describes two VHO algorithms, the operation are described with their advantages and disadvantages.

A. RSS based vertical handover algorithm

In the RSS based VHD algorithm that can make handover decision by comparing the RSS of the current point against another point or new point. Zahran, Chen and Sreenan [4] suggested algorithm for handover between 3G/cellular Networks and WLAN by combining it with the RSS with an estimated life time (it is the duration or time interval over which the current access technology remains beneficial to the active applications. There are two cases occur in VHO. In the first case a handover is initiated only when the moves from area covered by WLAN to cellular network and when average value of RSS in WLAN falls below the threshold level or estimated lifetime is less than handover delay then handover is triggered whereas In the second case when the mobile moves cellular to WLAN it switch/handover to WLAN if average RSS of WLAN is more than the threshold level then to wireless LAN is triggered. ALIVE HO allows the most desirable network continue as long as it gratify of desire the quality of service requirements of application. The main advantage of using this algorithm is to improve the bandwidth of the network. In the most populated area the received signal strength from any of BS or AP is given, RSS (d) measured in dBm, log-linear path loss channel propagation model with shadow fading effects is [5] expressed with formula as

$$RSS(d) = P_t - L - 10n\log(d) + f(\mu, \sigma) \quad (1)$$

Where PT defines the transmitted power, L is in equation1 a constant power loss, n shows the path loss exponent and has values between (2−4), d gives the distance between the mobile terminal (MT) and the wireless local area networks (WLAN) access point, and f (μ, σ) is shadow fading which is modeled as Gaussian having mean μ = 0 and standard deviation σ with values between (6–12) dB depending on the environment. We can use inter correlation function for the shadow fading that assumed exponential, taken in [6];

$$E[u(d_1)\,u(d_2)] = E[u(d_1)v(d_2)] = \sigma 2^{\exp}(-|d_2-d_1| / d_0) \quad (2)$$

Where do is the correlation distance. We also assumed that when the RSS is below a certain level or (threshold value α) the MT is unable to communicate with the AP.

1. RSS: If the new RSS attachment point is higher than the current point.
   RSS new point > RSS current point.
2. RSS with threshold: suppose that the new attachment point is higher than the current attachment RSS/point which is less than predefined threshold.
   RSS (new)>RSS(current) and RSS current<Threshold.
3. RSS with the Hysteresis: If the new attachment point RSS is greater than the current with Predefined Hysteresis margin.
   RSS new>RSS current +Hysteresis (H)

B Travelling Distance Prediction Based Algorithm.

A traveling distance prediction based algorithm is used to discard unnecessary handovers: Yan et al. [7] modified a VHD algorithm is taken into importance, that time the mobile terminal is expected to spend inside or enter in a WLAN cell. A handover to a WLAN is worked only when the coverage area of WLAN is available and the estimated traveling time inside the WLAN is larger than the time threshold. This method is relying on the estimation of WLAN traveling time, (this is the time that the mobile terminal is expected to spend inside the WLAN cell) and the reckoning of a time threshold.

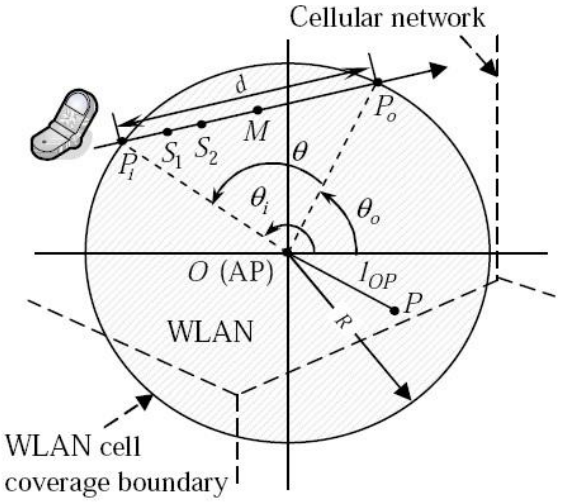

Figure3 Show Travelling Distance Prediction in WLAN cell

The figure 3 shows the connection between RSS and distance between the mobile terminal (MT) at any point p and the access point(AP) within the WLAN cell is to get by utilizing the path model criteria[8,eq.1]

$$RSS_P = E_t L_{OP}^{-\beta} 10^{\varepsilon/10} \quad (1)$$

Where we find E_t represents the transmitted power measured in mW and β is given as path loss exponent having value between 2and 4 and *E* represents Gaussian distributed random variable having zero mean standard deviation value is capable to12db [9], *lop* is define the distance between P (mobile terminal) and AP, suppose that two points P_i and P_o of MT_{be} the starting and ending points of WLAN cell, middle point is M. hence, the distance l_{OPi} is calculated as

$$R \cong l_{OPi} = \left(\frac{E_t 10^{\frac{\varepsilon}{10}}}{RSS_{Pi}}\right)^{1/\beta} \quad (2)$$

RSS changing rate is given as[10]

$$\Delta RSS = \left| \frac{RSS_M - RSS_{Pi}}{t_M - t_{Pi}} \right| \quad (3)$$

$$= \left| \frac{[(R^2-d^2/4)^{-\frac{\beta}{2}} - R^{-\beta}]E_t 10^{\frac{\varepsilon}{10}}}{\frac{d}{2v}} \right| \quad (4)$$

To get change in Received signal Strength, when the mobile terminal entered in the WLAN area the MT takes two RSS samples (s1and s2). Suppose that $RSS_{s2} < RSS_{s1}$ the mobile terminal cross the middle point (M) of trajectory. After passing the point M the signal will not remain longer in WLAN to initiate handover, therefore it does not do handover. It calculates the change in RSS as formulated as:

$$\Delta RSS = \left|\frac{RSS_{S2} - RSS_{S1}}{t_{S2} - t_{S1}}\right| \quad (5)$$

The algorithm use MT is travelling at constant speed and RSS can be measured by mobile terminal in limited (short) time after it enters the WLAN. The main vantage of this algorithm is that it to reduce handover failures, needlessly handovers and raise the strength of best utilization of network. But the method depends upon sampling and average of RSS points that introduced increased handover delay.

Quality of Services

Quality of services is the major consequence in vertical handover decision algorithm; it is defined as the number of call served to the number of call offered to the particular network.

QoS = call served/call offered

In percentage it is given as:

QoS (%) = (call served/call offered)*

The best result or 100 percent result is obtained when the number of call served is equal to the number of call offered, but this is not obtained because of number of factors such as fading, power loss and the most crowding. Quality of services (QoS) could be better if there is less call blocking and call dropping in the network.

V. CONCLUSION

Vertical Hanover Decision Algorithm is necessary for the fourth generation wireless heterogeneous network for seamless communication anywhere and still a challenging area .This paper give a brief review of VHO and its Algorithm. As Received Signal Strength and Quality of Service look various factor such as distance, transmitted power, surrounding condition, Gaussian noise and power loss should major contributor to RSS and to raise QoS parameter. In future we will designate to select the best network to calculate the other parameters such as security, cost and other parameter of vertical Handover.

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