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Vertical Handover for Network Selection in Heterogeneous Network

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Abstract - *The next generation wireless network consist of terminals with multiple access interfaces and services which are used by mobile users moving between heterogeneous networks. The main issue in such type of environment is that "always best connection". According to this, the mobile users need best connectivity anywhere at any time. In this paper, the handover strategies have been proposed, which helps the user in the selection of best network. The proposed algorithm is used for the decision making of handover process to the most suitable base station. The signal strength is kept at higher level than threshold level to minimize the redundant handovers. The proposed hysteresis method is compared with the existing received signal strength approach.*

Keywords: LTE, WiMAX, Handover cycle, RSS, MMTT, RSS with hysteresis.

1. INTRODUCTION

Now-a-days, wireless networks are providing good and flexible communication over large distance. The technologies which are used in these networks are developing more due to increasing demand of mobile users. These technologies are required to provide different services and applications with good quality of services. There are many types of technologies are available but the main technologies are WiMAX technology and LTE technology. WiMAX is a fourth generation standard and it is wireless broadband technology which support both licensed and unlicensed bands. It is useful where the high data rate and mobility services are required. The IEEE 802.16e standard is also known as mobile WiMAX. It supports 2.5GHz range of frequency and bandwidth of 5MHz -20MHz. The key feature of this technology is to provide high data rate and less delay, for this the OFDMA air interface is used with higher order modulation scheme i.e. 64 QAM. In this technology users have limited resources that are limited transmission power, limited number of antennas and limited computation capabilities, but the base station has higher transmission power, more number of antennas and more number of computational algorithms.

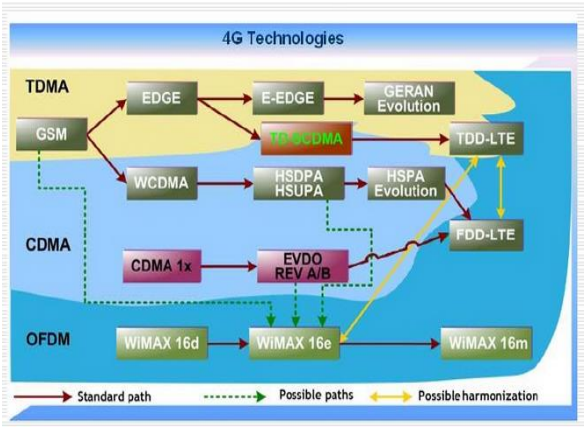

Fig-1: Evolution of WiMAX and LTE technologies

On the other hand, LTE is also a fourth generation standard, it is an advanced version of GSM and UMTS technologies. It has high speed data rate and more capacity which make it different from other technologies. LTE also stands for 4G LTE, which is five times faster than 3G. It can provide download speed up to 100mbps and upload speed of 50mbps.The LTE 4G networks uses different frequencies to transmit data. In this type of network it is able to stream videos without buffering. It uses OFDMA technique for transmitting more data on the same amount radio frequency. This technique is able to reduce latency and interference due to the use of different carriers by the users. The LTE can support 2GHz of frequency.

Table -1: Comparison between Wi-MAX and LTE

Parameters	Wi-MAX	LTE
Bandwidth	5MHz-20MHz	5MHz
Frame duration	10ms	5ms
Speed can handle	120 km/h	450 km/h
Compatibility	Not compatible with 2G and 3G	Compatible with 2G and 3G
Cost	Less	more
Deployment	Cheaper	costly
Data rate(uplink)	25Mbps	50 to 86.4Mbps
Frequency	2.5 GHz	2GHz
Data rate (downlink)	75 Mbps	100 to 326.4 Mbps

Now, the movement of mobile users from one technology to another i.e from WiMAX to LTE is known as vertical handover. To handle this handover process different approaches are used like RSS approach, MMTT approach etc. The approach which is introduced in this paper is the RSS with hysteresis value approach which provides better results than RSS approach.

1.1 Handover

It is a process in which mobile user moves from one base station to another due to this the point of attachment of user changed, this process is known as handover. The wireless network is in the form of cells, therefore when the user transfers from one cell to another is also known as handoff. There four types of handover:

- **Soft handover:** It is based on make-before –break handover which means that the mobile node is able to communicating with multiple access networks simultaneously.
- **Hard handover:** It is based on the break-before-make handover which means that mobile node is connected to the new link after previous link is broken.
- **Horizontal handover:** The handover take place between the cells of same wireless access technology e.g. handover between two LTE cells. This is known as horizontal handover.
- **Vertical handover:** The handover occurred between the cells of different wireless access technologies e.g. handoff between WiMAX and LTE. This is known as vertical handover.

2. HANDOVER CYCLE

There are three handover phases:-

a. Initiation phase
b. Decision phase
c. Execution phase

a. Initiation phase: The handover is initiated by mobile or network. If the received signal strength is below the threshold level then handoff is initiated by the mobile. But if there is heavy traffic on significant router then users are transferred to another router this type of handoff is initiated by the network.

b. Decision phase: In this phase, the target network is selected to which mobile node is transferred. The information regarding target network is collected and measurements are done on radio transmitters. On the basis of measurements of different parameters, the target network is selected.

c. Execution phase: After the network selection procedure, the new link is established between the mobile node and target base station. The current network transfers the information regarding mobile node to the target network. After that the mobile node is disconnected from the previous network and connected to the new one. In this phase, new registration and care of address is provided to the mobile node.

3. PREVIOUS APPROACHES FOR HANDOVER PROCESS

3.1 RSS Prediction Approach

In this approach only one parameter is required that is received signal strength (RSS) from mobile station (MS) to base station (BS). With the help of this approach, the RSS value from all nearest BSs is measured for n-intervals of time. After that, the BS with highest RSS value is selected as target BS. The RSS value is calculated by using formula:

$$RSSi\ (MS) = PTi + GR + GTi - PLi - LTi - LR$$

Where RSSi (MS) is RSS value at MS from BSi (target base station), PTi is the transmission power of BSi, GR

and GTi are the antenna gains of both MS and BSi, PLi is the path loss between BSi and MS, LTi and LR are the thermal receiver noise in both BSi and MS respectively.

The main disadvantage of this approach is that when the fluctuations occurred in the RSS value, the handoff is also fluctuated. Due to this the mobile users do not get the stable connection.

The vertical handover decision algorithm which is used in this approach is shown in following figure:

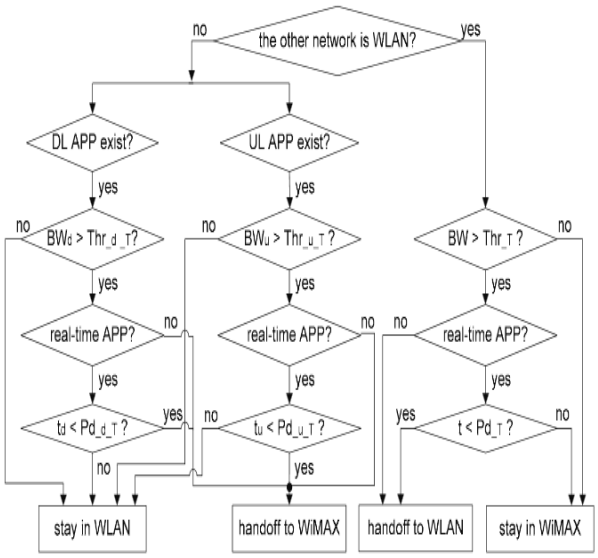

Fig-2: Vertical handover decision algorithm

3.2 MMTT Approach

This approach **is** used to determine the most suitable technology like WiMAX and LTE. This approach requires many parameters like RSS, bandwidth, connection cost and delay for the determination of suitable technology. This approach maintains the RSS level higher than the threshold level which helps to reduce the number of redundant handovers. In this, the target technologies have to satisfy four conditions:-

a) RSSk > RSSth
b) Ck < Cth
c) Dk < Dth
d) Bk > Bth

Where RSSk is the RSS value of evaluating technology and RSSth is threshold value of RSS, Ck is connection cost for target technology and Cth is its threshold value, Dk is technology handover process delay and Dth is threshold delay, Bk is technology bandwidth and Bth is threshold bandwidth. In this approach, the self learning algorithm is used to update the threshold levels.

The main problem occurs in this approach is that fluctuations take place in the number of handoffs.

4. PROPOSED APPROACH FOR HANDOVER PROCESS

4.1 RSS with fixed hysteresis approach

This approach overcome the disadvantages of previous approaches i.e it minimizes the number of redundant handoffs. This approach is used for the prediction of the technology in the vertical handover process. With the help of this approach the calculation of the RSS value is done by using the concept of transmitted power and fading. There are two types of fading: slow fading and fast fading. Slow fading occurs due to buildings and fast fading due to multipath components. Slow fading is calculated by using formula:

Slow fading = path loss model + shadow fading

Where shadow fading is considered as zero.

Pk = 32.44 + 20log10R(km) + 20log10f(MHz) – Gt(dB) – Gr(dB)

Here Pk is the propagation loss, R is the distance of mobile node from BS and f is the frequency of the network. Gt and Gr are the antenna gains of transmitter and receiver respectively.

When the RSS value is calculated by this method, then the RSS value of the serving BS is compared with the target BS by using formula:

$$RSSx + h < RSSy$$

In this formula, RSSx is the received signal strength from the serving base station and RRSy is the received signal strength from target base station. H is the hysteresis value. If above given condition is satisfied then the vertical handover process should take place.

5. RESULTS AND DISCUSSION

5.1 Response of path loss and received power of signal

To find out the handover performance, we have to check out the response of path loss and received signal power of mobile node when it moves from one base station to another. When the user moves from BS1 to BS2 its path loss increases but the received power decreases. On the other hand, from BS2 to BS1 the path loss decreases but the received power increases. In the result, the figures show the relation between the path loss and distance and also between received power and distance.

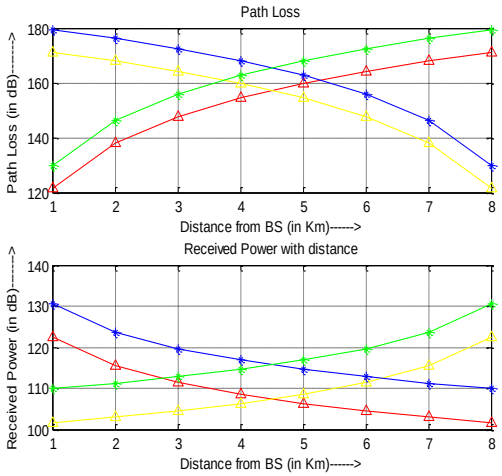

Fig-3: Response of path loss and received signal power

5.2 Selection of network

First of all in this number of evolution networks are selected, then threshold values for bandwidth, received signal strength and estimated time are selected. After that the network which has the bandwidth and received signal strength greater than the threshold value that network is selected as the target network. In this figure we select the 4 number of networks, here the fourth network have the bandwidth and received signal strength greater than threshold value therefore this is selected as target network.

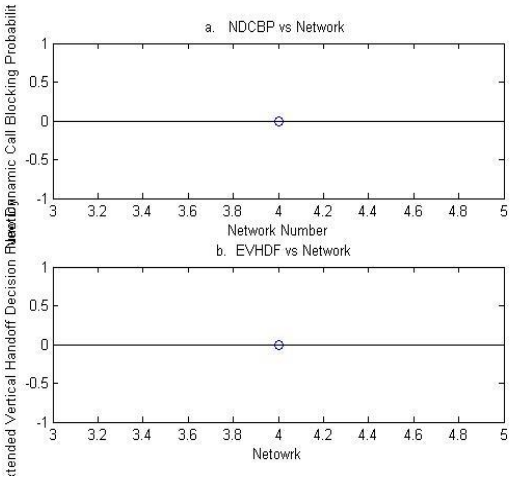

Fig-4: Network selection

5.3 Result for dynamic hysteresis

The figure shows the relation between the hysteresis value and average number of handoffs. In this figure the simple RSS approach and MMTT approach have the fluctuations in handover process which mean number of redundant handovers occurred, but in case of dynamic h with all adjacent BSs the result is without fluctuations which mean it reduces the number of redundant handoffs.

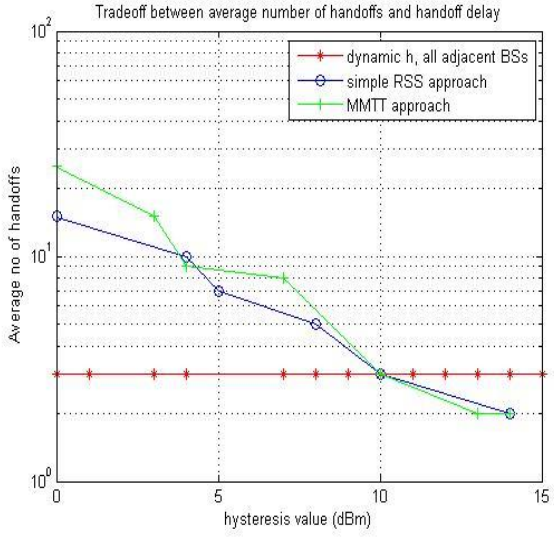

Fig-5: Dynamic hysteresis for handover process

6. CONCLUSION

The purpose of this paper is to select the best network from the heterogeneous networks. For this purpose different parameters like bandwidth and received signal strength are used to find out the performance of

handover. Therefore, the BS which has the higher value of bandwidth and received signal strength is selected as target BS. Also the hysteresis technique which is proposed in this paper helps to minimize the number of unnecessary handoff and give the better results.

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