International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 2 Issue 4, April-2013, pp: (140-151), Available online at: www.erpublications.com

Performance Evaluation of Mobile Wimax Networks

Harnek Singh[1], Harpreet Singh Bedi[2], Gurpreet Singh[3], Satinder singh[4]

Abstract: Mobile had made the life of today's world easy to communicate anywhere while Mobile terminals allow users to access service while on the move. Mobile terminals have made a rapid development in the mobile network industry in past decade. However as the number of cellular subscriber's increases, the interference that will be experienced by the systems will also increase. This means that many large cellular systems will, sooner or later, have to handle interference problems. In this paper, all handoff effects of mobile Wimax networks are carried out. Performance is evaluated in terms of the expected number of handoffs, the expected handoff delay, standard deviation of handoff location, and the expected link degradation probability as well. The results showed that the threshold and hysteresis margin of the handover should be selected by considering the tradeoffs between the "ping-pang" effect and the extra interference causing to neighbouring cells due to the poor quality link. After that some work has been done on the concept of smart handover manager. The main goal of this thesis is to reduce the handover latency. The handover latency of mobile Wimax is below 50 ms with the travelling speed of mobile station.

Keywords: QoS, SINR, MAC delay, RSSI downlink (DL) and uplink (UL), handoff, cellular communications.

I. INTRODUCTION

The growing demand for mobile Internet and wireless multimedia applications has motivated the development of broadband wireless-access systems in recent years. Mobile Wimax was the first mobile broadband wireless-access solution based on the IEEE 802.16e-2005 standard that enabled convergence of mobile and fixed broadband networks through a common wide area radio access technology and flexible network architecture. The mobile Wimax air interface is using orthogonal frequency division multiple access (OFDMA) as the preferred multiple access method in the downlink (DL) and uplink (UL) for improved multipath performance and bandwidth scalability. In the context of ubiquitous connectivity, a mobile station equipped with an IEEE 802.16interface is likely to roam across multiple base stations in order to maintain connectivity. However, as in most mobility scenarios, finding the target base stations that best fits the Mobility path and application requirements is far from being trivial. Generally the mobile device needs to scan multiple channels in order to find neighbouring base stations (BSs) and select an appropriate target. This selection can be based on different criteria, for example, measured signal strength, packet delay, error ratio, throughput, and security levels. Furthermore, since channel scanning can be relatively time consuming and causes quality of service (QoS) to degrade, it is preferable for the mobile station (MS) to perform this scanning and obtain a list of neighbouring BSs before it is ready to perform a handover. In fact, the IEEE 802.16e extension standard supports temporarily suspending the communication between the BS and MS in order to perform channel scanning. During this scanning period both upstream and downstream packets are buffered at the MS and BS, respectively.

The aim of this work is that a proper handoff mechanism must be defined to maintain uninterrupted user communication session during his/her movement from one location to another. Recently, in cellular communications, handoff is the process of transferring the serving base station (BS) of a mobile station (MS) from one to another when the MS moves across the cell boundary. A call in progress could be forced to abort during handoff if it cannot be allocated sufficient resources in the new wireless cell. A properly designed handoff algorithm is essential in reducing the switching load of the system while maintaining the quality of service (QoS).When an MS is travelling from its serving BS to the target adjacent BS, the probability of handoff is generally designed to maximize at the cell boundary. Traditional handoff decision algorithms depend on comparing the differential signal power level between the serving BS and target BSs to a constant handoff hysteresis value h. This hysteresis value is designed to reduce the ping-pong effect in the handoff procedure. Therefore, selection of this hysteresis value becomes important for optimizing handoff performance. If h is too small, numerous unnecessary handoffs may be processed, which increases the network burden. On the other hand, if h is too large, the long handoff delay may cause a dropped-call or result in a low QoS. Two important performance indicators of a handoff algorithm are the average number of handoffs and the average delay of handoff, both of which need to be minimized. And there exists tradeoffs between these two conflicting performance measures.

The size of handoff area is also a very important criterion related to handoff. Handoff area should be small enough to avoid cell-penetrating or cell-dragging, which will increase interference to adjacent cells and result in the decrease of throughput of the system. Standard deviation of handoff location is an index of the size of the handoff area. MSs have recently been given the ability to continuously trace the mobile location through various radio location techniques such as the Global Positioning System (GPS) [1][2].Therefore, the distance between the MS and the serving BS can be known. In this study, an adaptive handoff scheme is developed by dynamically determining the hysteresis value as a function of the distance between the MS and the serving BS.Since we vary the handoff hysteresis value based on MS's location, it can intelligently reduce the probability of unnecessary handoffs and maintain the quality of service Handoff mechanism handles subscriber station (SS) switching from one Base Station (BS) to another. The spectrum band is divided into some fixed bandwidth frequencies and these frequencies are reused in non-interfering cells smaller cells make an active mobile station (MS) to cross several cells during an ongoing conversation. This active call should be transferred from one cell to another cell in order to achieve call continuation during boundary crossings. Handover process is transferring an active call from one cell to another. The transfer of current communication channel could be in terms of time slot, frequency band, or code word to a new base station (BS), which leads to different techniques of handover. If new BS has some unoccupied channels then it assigns one of them to the handover. If all of the channels are in use at the handover time there are two possibilities: to drop the call or delay it for a while. In order to evaluate the efficiency of handover, two of the most important metrics for evaluating a handover technique are forced termination (call dropping) probability and call blocking probability. The aim of a handover procedure is to decrease forced termination probability while not increasing call blocking probability significantly.

This paper is organized as follows: Section II describes the handoff operation and its types. In section III presents handover performance in the mobile Wimax, based on the signal strength of handover between the two BSs. The call blocking and dropping probabilities are then discussed. Finally section IV represents the simulation results based on the project implementations. and finally the conclusion and future works related to the paper

II. HANDOFF OPERATION

a) Initialization of a Handover

Handover initiation is the process of deciding when to request a handover. Handover decisions based on received signal strengths (RSS) from current BS and neighboring BSs. . Figure1 shows the RSSs of current BS1 and one neighboring BS2. The strengths of received signal are varying in according with the distance the MS traveling between them. The RSS gets weaker as MS goes away from BS1 and gets stronger as it gets closer to the BS2 as a result of signal path loss. The received signal is averaged over time using an averaging window to remove momentary fadings due to geographical and environmental factors.

b) Relative Signal Strength

The mobile station is handed off from BS1 to BS2 when the signal strength atBS1 first exceeds that at BS2. In Figure1, BS2’s RSS exceeds RSS of BS1 at point A and handover is requested. Due to signal fluctuations, several handovers can be requested while BS1’s RSS is still sufficient to serve MS. There unnecessary handovers are known as ping-pang effect. As the number of handovers increase, forced termination probability also increases. So handover techniques should avoid unnecessary handovers.

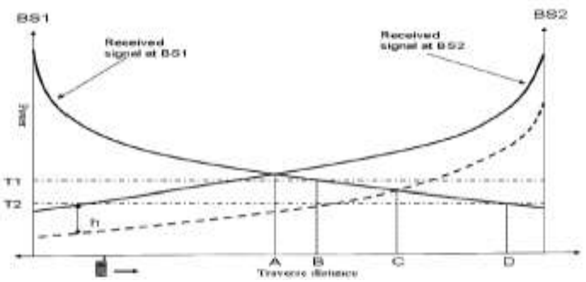

Figure1: Handover Decision as a Function of Handover Scheme

c) Relative Signal Strength with Threshold

Handover only occurs if first, the signal at the current BS is sufficiently weak and second, the other signal is the stronger of the two. The intention is that as long as the signal at the current BS is adequate, handover is unnecessary. So the relative signal strength with threshold introduces a threshold value (T1 in Figure1) to overcome the ping-pang effect. The handover is initiated if BS1’s RSS is lower than the threshold value and BS2’s RSS is stronger than BS1’s. The handover request is issued at point B at Figure1.

d) Relative Signal Strength with Hysteresis

This technique uses a hysteresis value (*h* in Figure1) to initiate handover. Handover is requested when the BS2's RSS exceeds the BS1's RSS by the hysteresis value *h* at point C in figure1.

e) Relative Signal Strength with Hysteresis and Threshold

This technique combines both the threshold and hysteresis margin to come up with a technique to reduce the number of handovers. Handover occurs only if first the current signal level drops below a threshold, and second the target base station is stronger than the current one by a hysteresis margin *h*. In our example, handover occurs at point C if the threshold is T1 and at D if the threshold is at T2.

f) Handover Decision

There are three types of handover decision protocols used in various cellular systems: network controlled handover (NCHO), mobile assisted handover (MAHO), and mobile controlled handoff (MCHO) [33, 34].Network controlled handover (NCHO) is used in first generation cellular systems such as Advanced Mobile Phone System (AMPS) where the mobile telephone switching office (MTSO) is responsible for overall handover decision. In NCHO, the network handles the necessary RSS measurements and handover decision .In Mobile assisted Handover (MAHO), the load of the network is high sincere work handles the all process itself. The objectives of handover can be summarized as follows:

- Guaranteeing the continuity of wireless services when the mobile user moves across the cellular boundaries.
- Keeping required QoS.
- Minimizing interference level of the whole system by keeping the mobile linked to the strongest BS or BSs.
- Roaming between different networks.
- Distributing load from hot spot areas.

g) Handover in Mobile Wimax Systems

In mobile Wimax, the handover process is defined as the set of procedures and decisions that enable an MS to migrate from the air interface of one BS to the air interface of another and consists of several stages. Figure1 shows the procedures of initial network entry (encircled in dashed line) and handover for the mobile Wimax. It can be seen that the two procedures are vary similar to each other. Generally, the decision for a handoff can be determined based on various properties and values. The decision attribute is a combination of network conditions, system performance, application types, power requirements, MS conditions, user preferences, and security. The network conditions and system performance can be improved by balancing the load of heavily occupied BSs to less active BSs, assuming possible within other requirements. Different applications in the mobile device can set requirements to the currently serving BS and it might be that it does not support all the needed technologies. Additionally, if
a new BS can provide sufficient service with better power saving or security properties than the currently serving BS, it can be useful for the MS to perform a handover to the new one.

h) Handover Process and Cell Reselection

In Figure, the handover process of mobile Wimax is demonstrated that consists of several stages: cell reselecting, handover decision and initiation, synchronization to the target BS, ranging with target BS, and termination of context with previous BS.

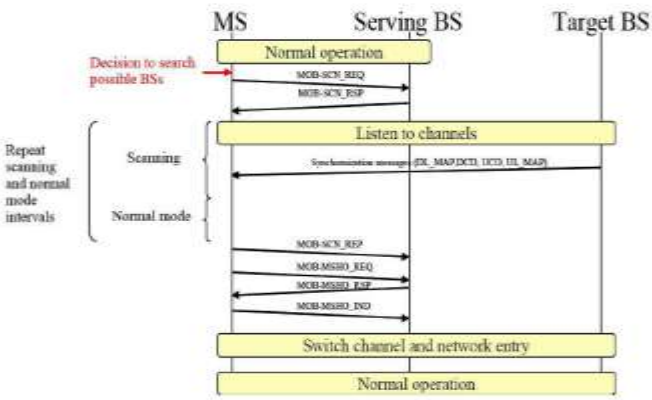

Figure 2: Process of Handover in Mobile WiMAX System

i) Cell Reselection

During this stage, the MS performs scanning and association with one or more neighboring BSs to determine their suitable as a handover target. After performing cell reselection, the MS resumes normal operation with the serving BS.

j) Handover Decision and Initiation

The handover process begins with the decision for the MS to migrate its connections from the serving BS to a new target BS. This decision can be taken by MS, BS, or some other external entity in the mobile Wimax network and is dependent on the implementation. When the handover decision is taken by the MS, it sends MOB-SCN_REQ message to the BS, indicating one or more BSs as handover targets. The BS then sends a MOB-SCN_RSP message indicating the target BSs to be used for this handover process. When the handover decision is taken by the BS, it sends MOB_BSHO_REQ message to the MS, indicating one or more BSs for the handover target.

k) Synchronization to the Target BS

Once the target BS is determined, the MS synchronizes with its DL transmission. The MS begins by processing the DL frame preamble of the target BS. The DL frame preamble provides
the MS with time and frequency synchronization with target BS. The MS then decodes the DLMAP, UP-Map, DCD, and UCD messages to get information about the ranging channel. This stage can be shortened if the target BS was notified about the impending handover procedure and had allocated unicast ranging resources for the MS.

III. HANDOVER MANAGEMENT

Several references used a two-BS model that is simple and widely used for evaluating signal strength based algorithms. This model is suitable for small macrocells and LOS handovers in microcells.. The simulation model systems consider both the transmission and traffic characteristics. Such combined analysis of transmission and traffic characteristic provides a more realistic scenario for performance evaluation of a cellular system. The performance of an SHO algorithm suitable for a CDMA system was analyzed in Simmonds studied the application of soft handover (SHO) in wideband direct sequence CDMA (DS-CDMA) systems. Exploitation of diversity in the cell overlap region provides better handover performance but requires additional resources. A compromise between diversity usage and resource utilization was analyzed. The handover performance is quantified by the performance measures such as active set updates, number of BSs involved in SHO, and outage probability. In, the handover was associated with adaptive channel scanning depending on the link condition. With association level 2, the handover duration can be reduced dramatically. Our simulation is based on this algorithm by modifying scanning duration, contention window size, scan request timeout, and the velocity of MS to analyze the impact on the handover latency.

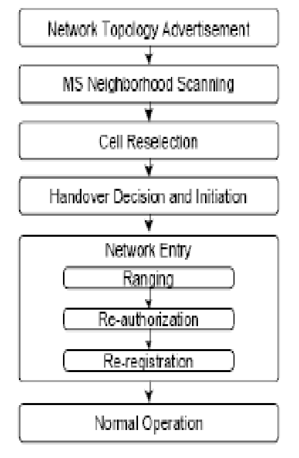

Figure3. Handover process

a) Signal Strength Base Algorithm

The frequencies used in mobile communications are normally above 30 MHz and the maximum link lengths do not exceed 25 to 30 km. Macrocells in current 2G (second generation) or 3G (third generation) systems are much smaller. Generally, the transmitted signal, as it propagates away from the transmitter, experiences three different rates of variation, namely, very slow variations, also known as path loss, which are distance dependent, slow variations, mainly due to shadowing effects, and fast variations, due to multipath.

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The received signal is averaged over time using an averaging window or by means of filtering to remove out fast variations due to the geographical and environmental factors. So the received signal by MS can be suitably considered to be containing only two components: path loss and shadowing variations. Expressions for calculating the path loss, L (dB) for urban, suburban and rural environments are provided. For flat urban areas,

$$L(dB)= [69.55 +26.16\log(f) -13.82\log(h_t) -a(h_m)]+ [44.9\ 6.55\log(h_t)]\log(d) \qquad \text{eqn1}$$

where f is in MHz, ht and hm are in meters and d in km. Parameter ht is the BS effective antenna height and hm is the MS height, and d is the radio path length. For an MS antenna height of 1.5 m, a(hm)=0. For a medium-small city,

$$a(h_m)= [1.1\log(f) - 0.7]h - [1.56\log(f) - 0.8] \qquad \text{eqn2}$$

In order to accommodate the need to deploy higher frequency systems, such as the GSM at1800 MHz or PCS at 1900 MHz, a new revision of Hata model was developed using similar method to those used by Hata. The Hata model follows the express,

$$L(dB) =[46.3\ 33.9\log(f) -13.82\log(h_t)-a(h_m)] +[44.9- 6.55\log(h_t)]\log(d) +C_m \qquad \textit{eqn 3}$$

where a(hm) has the same expression as in the original model and Cm is equal to 0 dB for medium-size cities and suburban centers, and equal to 3 dB for metropolitan centres. The very slow variations, shadowing variation can be modelled as a power law, i.e., 1/dn, where the exponent, n in typical cellular applications is close to 4.The slow variations, can be represented by the expression

$$P(d) =P- 10n\log(d_{km}) +N(0,L) \qquad \text{eqn4}$$

where P(d) is the received power at a distance d(km), P1km is the received power at 1 km, n is the power decay law and N is a Gaussian random variable of zero mean and standard deviation, L, called the location variability. It should be pointed out that P1km is used in macrocell scenarios, In other cases where radio paths are shorter, e.g., indoor or urban microcells, other reference distances such as 1 m or 100 m are used. We performed simulations for a frequency of 2 GHz, the larger area mean is 70 dBm, location variability is 7 dB, and the correlation length is set to 30 m. The simulation scenario is like: MS is assumed to travel from BS1 to BS2 which are 6 km apart. Somewhere halfway between both BSs, the averages of the received signals are very similar in level. A threshold and a hysteresis margin are defined so that two HO algorithms, HO based on relative signal strength with threshold and HO based on Relative signal strength with threshold and hysteresis margin, can be simulated. Figure 5.1 illustrates the two received signals by the MS and the HO threshold and hysteresis margin above it. The smooth lines are the path loss of signal with distance increased from BSs. The fluctuation is due to the shadowing variations. The HO based on relative signal strength with threshold just performs the switch whenever the received signal is below the threshold and the alternative signal is larger.

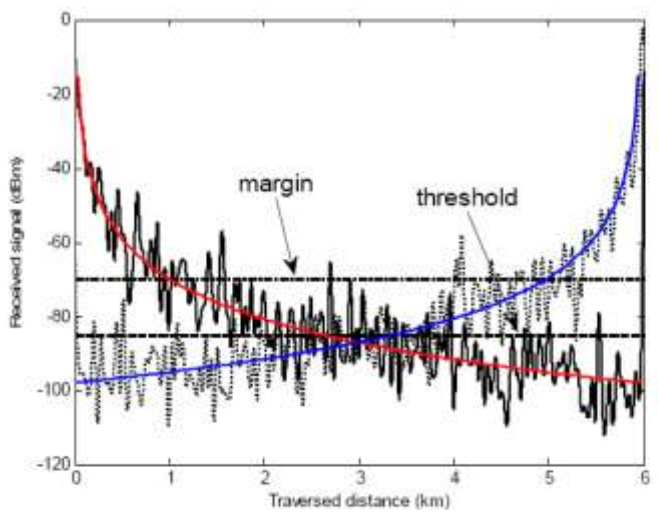


Figure4: Signals from Two BSs, and HO Threshold and Hysteresis margin

Figure 5 demonstrates the numerous switches handover flip-flops that take place if you only set the threshold level. If a margin is taken into consideration in the HO algorithm so that, in order to switch back to the former BS, the difference between received signals must be above such margin. From figure not only the number of BS changes is drastically reduced but also the time of the HO occurrence is delayed, so the load is reduced for the whole networks system.

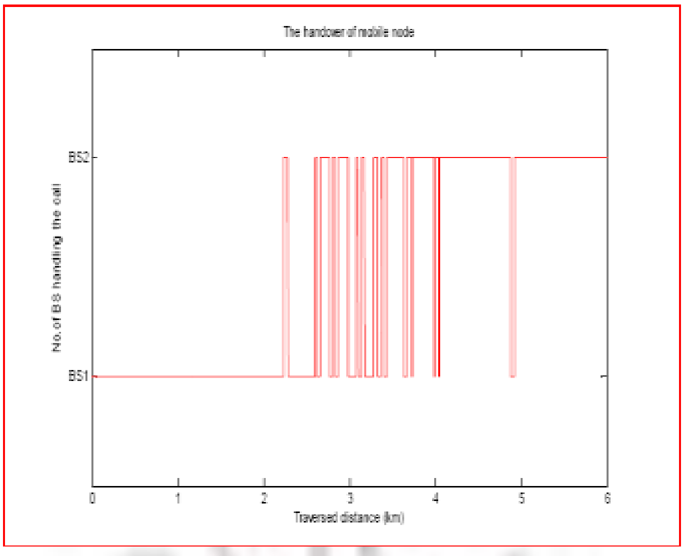


Figure5: HO Based on Relative Signal Strength with Threshold

b) The "Ping-Pang" Effect

The threshold is not used alone in actual practice. This will create conditions for unnecessary handover due to rapid fluctuations in the received signal strengths. So the hysteresis margin is introduced along with threshold. In cellular communications, handoff is the process of transferring the serving base station (BS) of a mobile station (MS) from one to another when the MS moves across the cell boundary. A call in progress could be forced to abort during handoff if it cannot be allocated sufficient resources in the new wireless cell. A properly designed handoff algorithm is essential in reducing the switching load of the system while maintaining the quality of service (QoS).

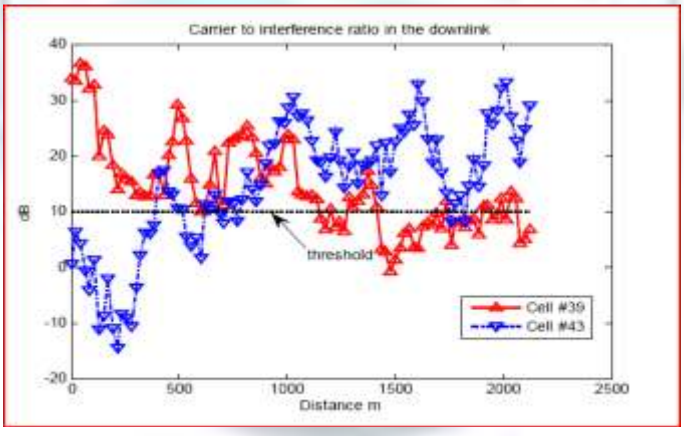


Figure 6: SIR Based Algorithm, Received Signal Level in the Downlink

c) Adaptive Handoff

When an MS is traveling from its serving BS to the target adjacent BS, the probability of handoff is generally designed to maximize at the cell boundary. Traditional handoff decision algorithms depend on comparing the differential signal power level between the serving BS and target BSs to a constant handoff hysteresis value h. This hysteresis value is designed to reduce the ping-pong effect in the handoff procedure. Therefore, selection of this hysteresis value becomes important for optimizing handoff performance. If h is too small, numerous unnecessary handoffs may be processed, which increases the network burden. On the other hand, if h is too large, the long handoff delay may cause a dropped-call or result in a low QoS. Two important performance indicators of a handoff algorithm are the average number of handoffs and the average of handoff, both of which need to be minimized. And there exists a trade offs between these two conflicting performance measures. The size of handoff area is also a very important criterion related to handoff. Handoff area should be small enough to avoid cell penetrating or cell-dragging, which will increase interference to adjacent cells and result in the decrease of throughput of the system. Standard deviation of handoff location is an index of the size of the handoff area.

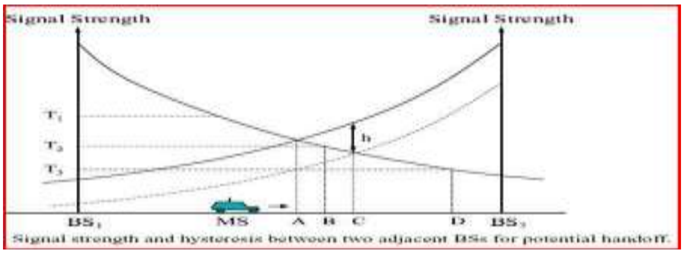
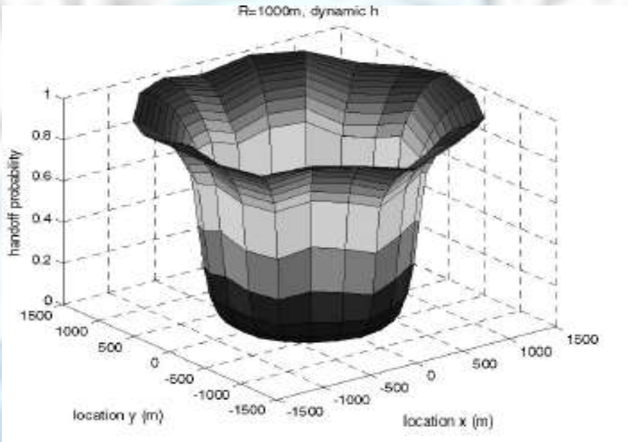


Figure7. Handover threshold

Therefore, the distance between the MS and the serving BS can be known. In this study, an adaptive handoff scheme is developed by dynamically determining the hysteresis value as a function of the distance between the MS and the serving BS. Since we vary the handoff hysteresis value based on MS's location, it can intelligently reduce the probability of unnecessary handoffs and maintain the quality of service .Since there is a tradeoffs between handover threshold and margin, an adaptive threshold window could be used to balance the load of base station and the QoS of the mobile. If the handover happens early before mobile entering the coverage of the target base station, the target base station has to allocate some resources to the call entry and it also causes unnecessary handovers. But, if the handover happens too late, the QoS will be hard to maintain due to the low SINR and interference from other cells. This is a potential research topic by selecting the threshold window (the gap between threshold and hysteresis margin) adaptively according to the SINR of the mobile station senses.



The handoff performances consider only two BSs and omit the effect of other adjacent BSs, which simplifies the performance analysis but results in inaccurate conclusions. In this study, we consider the influence of all six adjacent cells in the hexagonal cell model. We assume that each MS knows the distance between itself and the serving BS. We propose a handoff scheme with dynamic hysteresis value h, which is determined by the distance between the MS and the serving BS,

h = max{20(1 - (Dc/R), 0}, eqn5

where d, is the distance between the MS and the serving BS, and R is cell radius. 20 is chosen so that the handoff algorithm can control unnecessary handoff and react to the deep fading at the same time, which results in sudden drop (20 30 dB) of the received signal strength. And the exponent is set to 3, because it achieves best tradeoff between the key criteria As we can see, h decreases from 20 dB to 0 dB as the MS moves away from the serving BS. By setting the above dynamic hysteresis value h, the number of unnecessary handoff is decreased because of large h if the MS is near the serving BS, and MSs are encouraged to hand off to adjacent cells because of small h if the MS is near the boundary of the current cell. In this way, the handoff area is optimized.

Parameters	Description
D=2000 m	Distance between two BSs
R=D/sqrt(3)	Cell radius
K=30	Path loss factor
σ=5 dBm	Shadow fading standard deviation
d_{cor}=30 m	Correlation distance
v=20 m/s	Mobile velocity
t_s=0.5s	Sample time
Δ = -105 dBm	Threshold of link degradation

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d) Smart Handover Manager

According to literature survey, the Wimax 802.11 standard supports only the hard handover which means that the ms lost his connection and restart the process of synchronisation with a new base site. Hence it goes for break before make process. But for the seamless service the connection should be made with new bts before disconnecting from previous one. Hence a new handover manager should be made for the vertical handoff. The smart handover manager is the block in the layer protocol which controls all the handover steps. The handoff procedures are normally initiated when the stations move across the border of WLANs. As a result, both the fixed stations and the mobile stations within overlapped areas cannot benefit from VHOs. We highlight that a VHO could be initiated by two factors: mobility when a station moves out of the coverage of its connected WLAN, and QoS when the connected network cannot satisfy the requirements. Therefore, the QoS-triggered handoffs should be designed with an objective to provide ABC services for both mobile and fixed stations.
The main features of handover manager are:

- The smart handover manager is used to achieve proactive handoff.
- It controls all the handoff procedure.
- It works in between the media access control layer (MAC) and the network layer.
- It provides handover decisions mechanisms which can be based on many factors such as network availability, user profiles, application requirements or available resources.

e) Network condition detection and handoff decision

The main work is to decide whether the conditions of the other network that is not serving the station can satisfy the QoS requirements. The available bandwidth of the network is evaluated first. If the calculated result is larger than the threshold and a real-time application is running on the station, the average packet delay of the network will be further estimated. If the other network is WLAN, the network conditions are estimated based on the total radio resource since the medium of WLAN is contended by all stations including AP To make an effective handoff, it is required that the conditions of the target network must be good enough.

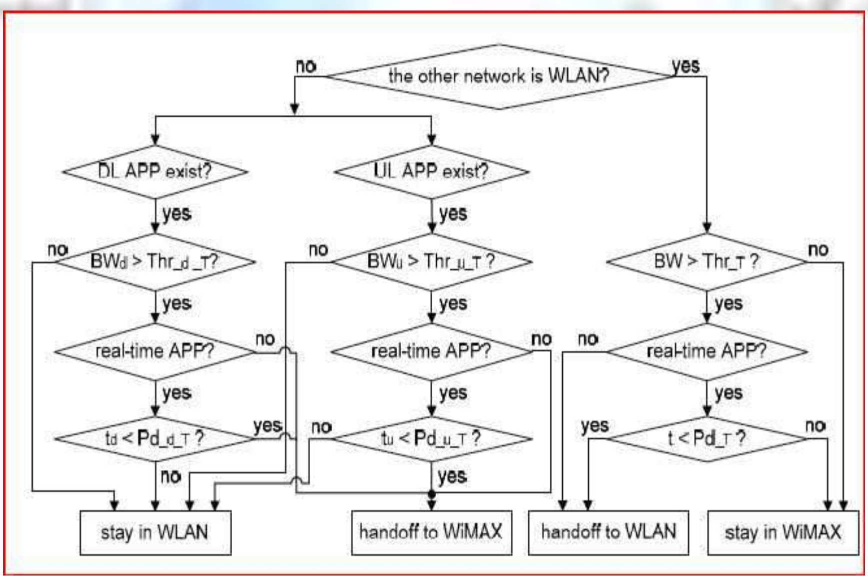


Figure 9: Handover decision making for mobile Wimax

f) Effect Of Distance Error

In this section, we consider the effect of distance error to our scheme. The measured distance is assumed to be Gaussian distributed, where the mean is the accurate distance and the standard deviation is std.

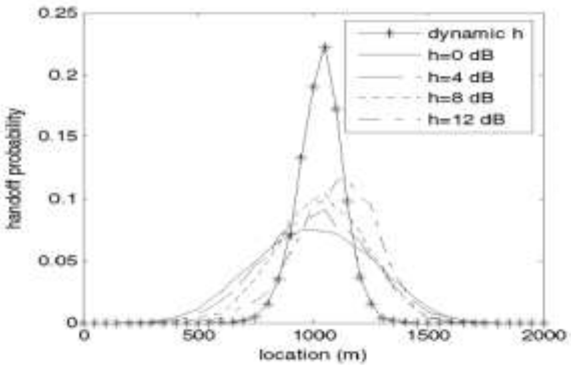
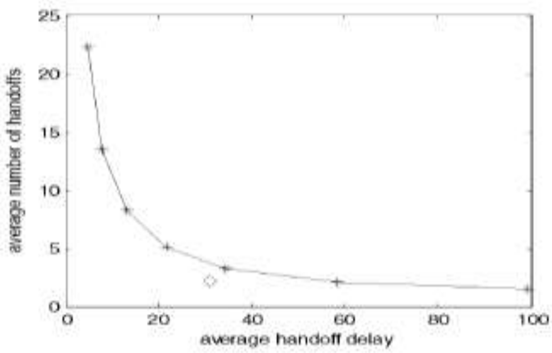


Figure 10: Handoff probability at different location



We can conclude that our adaptive handoff scheme is stable when the standard deviation of the measured distance is less than 60m, which means that our scheme is still feasible when only rough distance information rather than accurate distance information is available. When the standard deviation of measured distance is larger than 60m, the average number of handoffs and standard deviation of handoff location increase with std. On the other hand, the average handoff delay 25 decreases as std increases.

g) SIMULATIONS

The goal for simulation is to test the performance of handover in PHY layer and the properties of mobile Wimax in practice. In this chapter, we first implement the handover concept using
MATLAB and later on a very basic scheme is planned for the decision making for the handover with different algorithms. We have done the simulation in different steps. Firstly we have to make the environment for the handover simulation.

I. Simulation for Path loss

To check the handover performance, we have to check the response of the path loss and the received power signal of the mobile node when it moves from one base site to another.

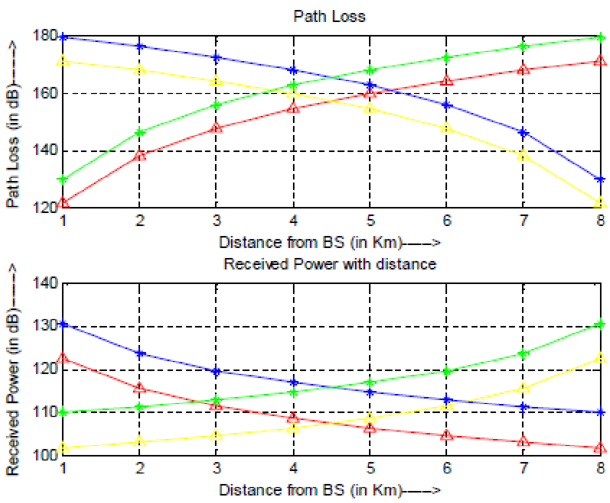


Fig 11: Path loss and Received power of mobile node.

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II. Simulation for Dynamic Hysteresis

We have designed a simulation system which consists of two base stations and a mobile node which is moving from one base site to another. the value which are taken are generally, for frequency we use value nominal for more than 30 MHz after that the height of the base site is mentioned .the base site is mainly of height from 25 metres to 60 metres. After that the height of the mobile node is given. Then we have to specify the area for which the simulation has been done. it can be urban area ,semi-urban and the large city. The figure represents that as the mobile node moves, the path loss increases and the received signal strength decreases .up to a particular threshold level the handover should take place, unless the call will be dropped or the connection is lost. when the MS moves away from the serving BS along a straight line from the serving BS to an adjacent BS. Our scheme shows the best performance,

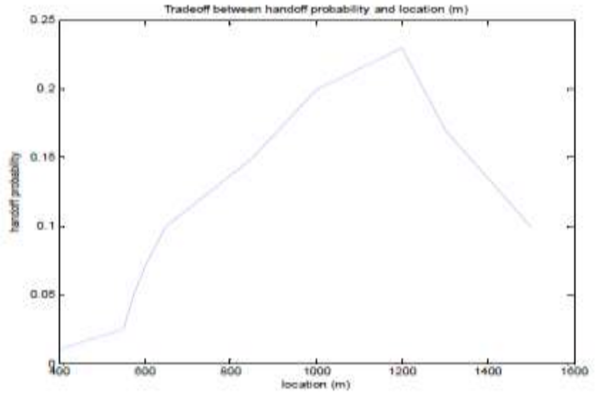
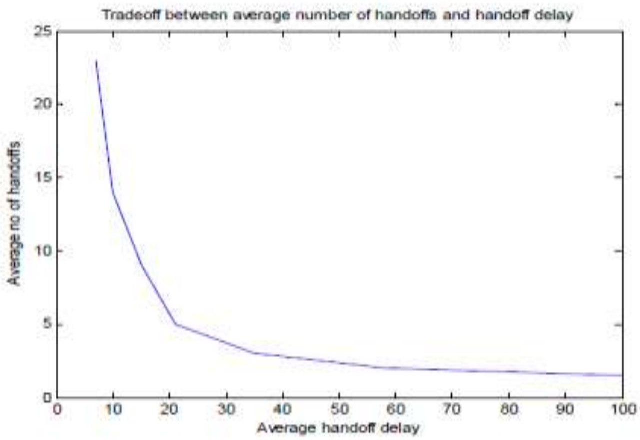


Fig.12: shows the probability of handoff

because the handoff probability of our scheme is the smallest when the distance is less than 800m, and it increases fastest from 0 to 1 in the handoff area near the cell boundary. Therefore, our scheme has the smallest handoff area, i.e., our scheme achieves the best handoff area. The handover should take place 1100 m .After that the handover probability decreases as the distance increases further.



As the hysteresis value increases, the figure of handoff probability shifts to the right, which means the increase of handoff delay. And the figure becomes more centralized with the increasing of the hysteresis value, resulting in the decease of the handoff area. As the handover delay increases the handover probability decreases. Hence we set the nominal value of 50 ms. After that the response of the average no. of handover with the hysteresis value .the observations can be seen:

As we keep the value of the hysteresis margin low, then the average no. of handover increases. Which cause the unnecessary handovers and increase the system load If we use the large value for h, then the average no. Of handoffs will decrease but the Handover delay will be more. But if we use the adaptive value for h.According to the distance then the no. Of handoffs are constant. Average number of handoffs and standard deviation of handoff location decrease with increasing hysteresis value h, average handoff delay and probability of link degradation increase as h increases. It can intelligently reduce the probability of unnecessary handoffs and maintain the quality of service. Analytical and simulation results show that the proposed scheme performs better than other schemes with static hysteresis value in terms of the average number of handoffs, average handoff delay, standard deviation of handoff location, and probability of link degradation.

International Journal of Enhanced Research in Science Technology & Engineering, ISSN: 2319-7463
Vol. 2 Issue 4, April-2013, pp: (140-151), Available online at: www.erpublications.com

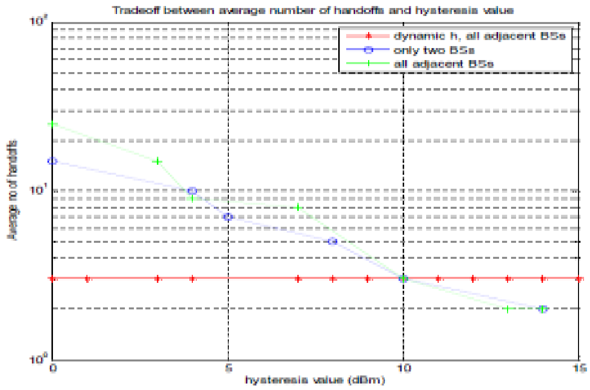


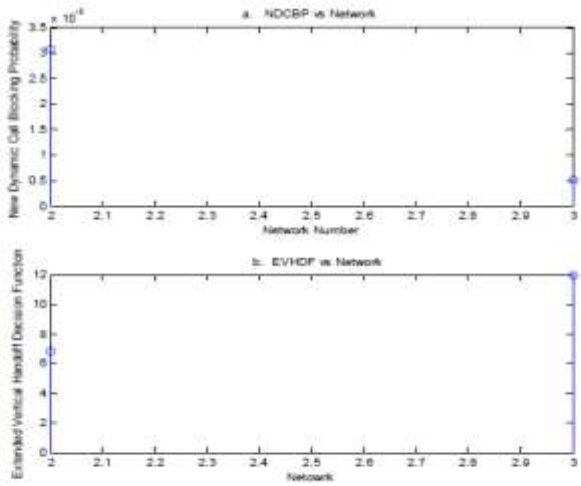
Fig 14: Average no. Of handoff with hysteresis value

III. Simulation for Handover Manager

The handover manager is used for the proactive handover. In this simulation ,we have mainly concerned with the decision making for the handover on the basis of some different parameters .There are many parameters like received signal strength, available bandwidth, path loss, mobile node power status. We have designed an simulation model which decide the base station for the shifting of mobile node is best and describes the handover probability and the blocking probability. For this, we have checked the response for the 3 network which are under evaluation the inputs can be given as:

- The number of networks under evaluation N: 3
- Enter the threshold values of various parameters when prompted.
- Threshold Current Available Bandwidth
- Threshold Received Signal Strength
- Threshold Estimated Time MS will be in present network
- Firstly the threshold values are set for which can be taken as reference. After that the current value of each network is feeded.
- Current Available Bandwidth
- Received Signal Strength
- Estimated Time MS will be in present network
- Power Dissipation in Network
- Mean number of request arrivals per unit time
- Mean number of calls serviced per unit time
- Power Consumption
- Network Conditions

We have made the scenario for 3 networks in which the current network has the values less than the threshold value and the values of the other two networks are more ,but the decision is made on the basis of parameter that on which network the handover should be done.



From the response observed during simulation that the call blocking probability is much higher for the network2 instead of network3.hence the handover probability is more for the network3.Perform handoff with Network 3 for best performance.

IV. CONCLUSION

The purpose of this research work is to study the basic concepts of cellular handover and the handover latency with the traveling speed of mobile station in mobile Wimax networks. Currently the Wimax standard states that hard handover is compulsory. Macro diversity handover and fast base station switching are both optional. Hence hard handover is the first focus of this work. First, we simulated the handover in the physical layer using MATLAB. Two handover scenarios have been studied. One is the handover only considering the threshold that causes numerous handover switching between serving base station and target base station, which puts some load to the system and reduces the performance of the whole network. The other is the handover considering both the threshold and hysteresis margin that tremendously reduces the unnecessary handover at the price of increased handover latency .After that the adaptive handover scheme is implemented which uses the dynamic value of hysteresis. We found that this scheme is far better than all other schemes .Hence unnecessary handovers are minimized. Secondly, we also simulated the handover manager in the mobile Wimax using MATLAB. The goal of this simulation is to find out the process how the proper decision should be made for the handover by the smart handover manager. As extension to this research work, two topics for future research investigations are suggested. One is the load balancing technique which can increase the system efficiency. Also, the current work is restricted to hard handover only. Possibilities of extending this work to macro diversity and fast base station switching can be worthy of an investigation. Although these are soft handover techniques and currently optional in the Wimax standard, the BS selection procedure based on location predication algorithms and current load factors of the target BSs give an alternative way of deciding the target BS. Further, reducing the number of handovers is highly desirable from a system perspective.

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