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# IMPLEMENT & ANALYSIS OF RSS THRESHOLD BASED VERTICAL HANDOFF DECISION ALGORITHM FOR LTE & WLAN

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**Abstract—** Communication services anywhere and anytime is driving an accelerated technological development towards the integration of various wireless access technologies such as WLAN, 4G and etc. MTs (Mobile Terminal) must be able to seamlessly transfer to the "best" access link among all available candidates with no perceivable interruption to an ongoing data, voice or video conversation. Such ability to handover between heterogeneous networks is referred to as vertical handovers. VHD (Vertical Handoff Decision) algorithm can be classified in to different four category 1) RSS (Received Signal Strength) based 2) Freq. based 3) cost based 4) combination. These algorithms need to be designed to provide the required Quality of Service (QoS) and different parameter to a wide range of applications while allowing seamless roaming among a multitude of access network technologies. In this paper, design an algorithm in which the handoff decision can be taken on the basis of the value of current RSS and threshold RSS and results are plotted using the Matlab code. The current location and velocity of users and the requirement of users and availability of network among them the best algorithm is chosen by the mobile station.

**Keywords—** Vertical handoff, RSS, Handoff delay, Handoff failure probability, Heterogeneous wireless networks.

## I. INTRODUCTION

Mobile wireless communications is one of the most advanced form of human communications ever. The intense research has led to rapid development in the mobile communication sector. One of the important objectives in the development of the new generation is the quality improvement of cellular service, with handovers nearly invisible to the mobile station subscriber. Generally, a handoff takes place, when the link quality between the base station and the mobile terminal is degraded on movement. In next-generation wireless systems, it is important for Radio Resource Management (RRM) functionality to ensure that the system is not overloaded and guaranteeing the needed requirements. If the system is not properly planned, it leads to low capacity than required and the QOS degraded. The system became overloaded and unstable.

There are two main areas for mobility management: location management and handover management. Point of attachment belongs to, the handover can be either horizontal or vertical. A horizontal handover takes place between points of attachment supporting the same network technology, for example, between two neighboring base stations of a cellular network. On the other hand, a vertical handover occurs between points of attachment supporting different network technologies, for example, between an IEEE 802.11 access point and a cellular network base station. A handover process can be split into three stages: handover decision, radio link transfer and channel assignment. Handover decision involves the decision to which point of attachment to execute a handover and its timing. Radio link transfer is the task of forming links to the new point of attachment, and Channel assignment deals with the allocation of resources. In this paper, design an algorithm in which the handoff decision can be taken on the basis of the value of current RSS and threshold RSS and results are plotted using the Matlab code. The current location and velocity of users and the requirement of users and availability of network among them the best algorithm is chosen by the mobile station.

## II. RELATED WORK

In [1] authors discuss the different types of handoff in the next-generation wireless systems and the recent trend of link-layer-assisted handoff management protocol design. Then, they analyse the performance of handoff management protocols that use a fixed value of RSS threshold to initiate the handoff process. Through their analysis, they observe that, when a fixed value of hysteresis used, handoff failure probability increases when either speed or handoff signalling delay increases. This information to calculate a dynamic value of RSS threshold for handoff initiation. Their analysis and simulation results show that CHMP significantly enhances the performance of both intra and intersystem handoffs. In [2] this paper, they presented a handover-based algorithm that adapts according to the load status of cells. A proper threshold value to control the handover initiation time according to the load status of cells, mobile's speed and handover types is used. This algorithm is developed to efficiently manage overloaded traffic in the cells and roll out the most precise or ideal time for handoff initiation. Also, a comparison of probability of handoff failure in case of fixed RSS and Adaptive RSS algorithm have been shown. Results prove that a better QOS is achieved in Adaptive RSS than fixed RSS scheme. In [3] they present two vertical handoff decision algorithms for a mobile node either staying in the UMTS or WLAN/WiMAX networks are proposed. Initially, the PRSS conditions are different for real-time and non real-time services. The proposed vertical handoff and network selection reduces packet delay and increases the throughput of WLAN/WiMAX networks. In [4] this paper, authors present the design and simulation of distributed distance-based scheme for vertical handoff in heterogeneous wireless networks and provide performance measurements using the MATLAB. 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. In [5] this paper, they have proposed a new handover triggering mechanism (DR-HTM) based on IEEE 802.21 MIH in order to improve capacity of not only LTE but also overall networks. In addition, they adopt Time-to-Trigger (TTT) mechanism in vertical handover between WLAN and cellular networks for efficient handover triggering. In [6] this paper, authors have determined the appropriate timing instants for initiation of vertical handover for the mobile terminals that enter the WiFi hotspots, stay there for some time and then leave the area. They have ensured that transition between cellular and WiFi networks should be with minimum disruption while utilizing WiFi signals for as long as possible.

## III. RSS THRESHOLD BASED ALGORITHM

### 3.1. Handover Scenario.

The flowchart for the algorithm is shown in fig.2. [7] This flowchart is shows that at which time the decision can be taken for the handoff. At starting of the algorithm first monitor the RSS value of both networks using the equation of RSS. After this, check the MS is in WLAN network or is in LTE network. If is in LTE network then the RSS value for LTE network is taken for the decision in algorithm. If LTE RSS decrease continuously then find the LTE threshold RSS value $RSS_{th}$. If MS moves towards WLAN network at that time LTE signal becomes weaker and WLAN signals becomes strong. After this, decision taken if the current LTE RSS value is less than threshold LTE RSS value and at the same time WLAN RSS is grater then LTE RSS threshold. If this condition is true, then MS hanover to the WLAN connection.[8]

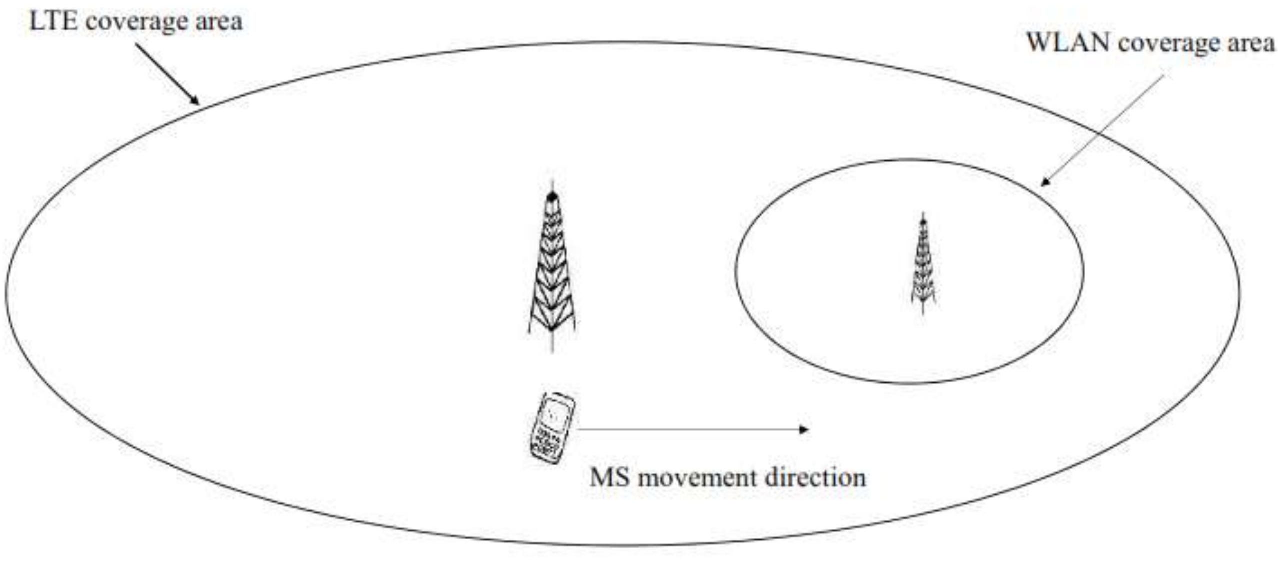


*Figure 1. Handover system model*

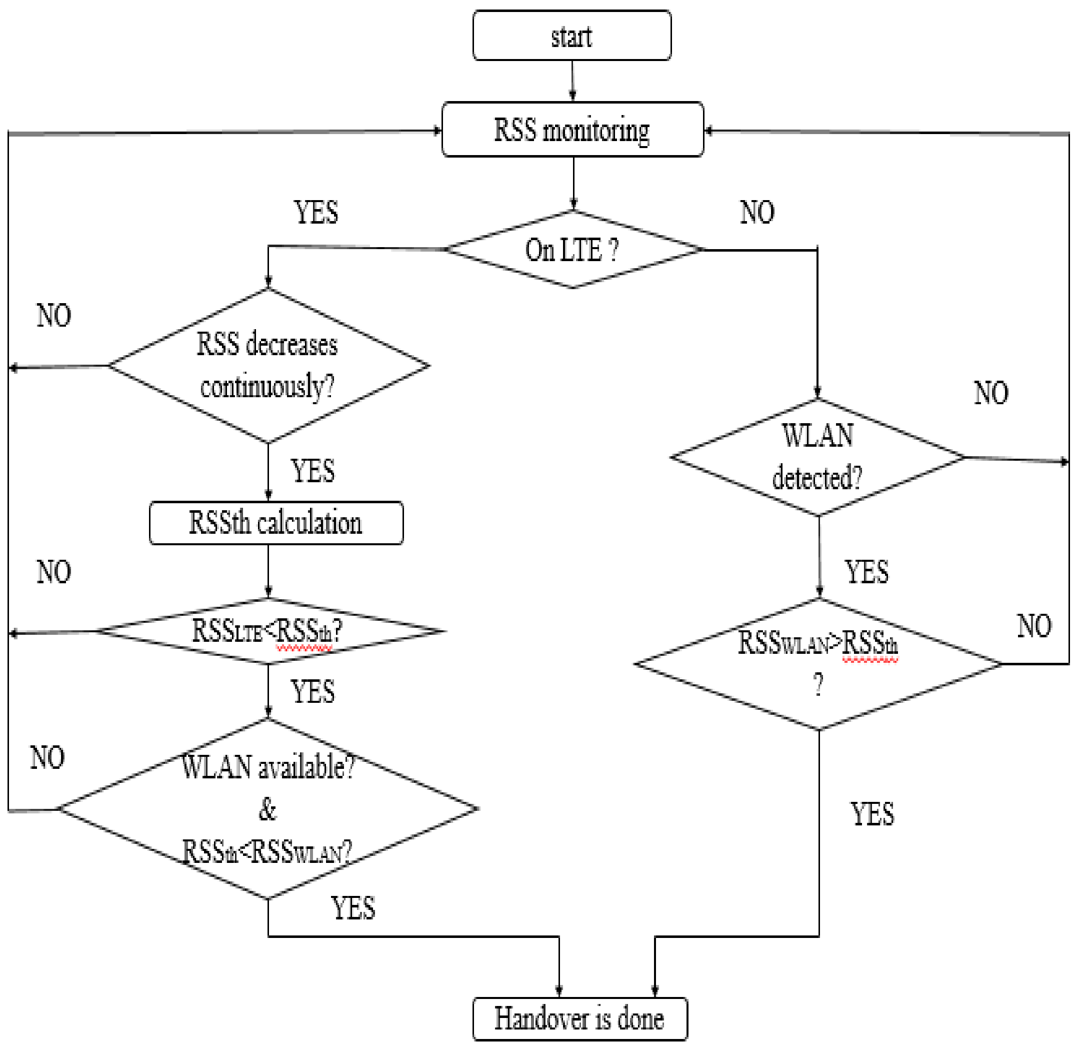


*Figure 2. RSS threshold Handover algorithm*

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### 3.2. Related Equations

Received signal strength (RSS) of both the networks calculated using below equation:

$RSS\ (dBm) = P_t\ (dBm) + K\ (dB) - 10\ n\ \log_{10} [d/d_0]$ (1)

$K\ (dB) = 20 \log_{10} [lammda / 4 *pi* d_0]$ [12] (2)

False handoff initiation probability calculated using below equation:

$P_a = 1-[(1/pi)*(atan(a/2d))]$ (3)

False handoff failure probability calculated using below equation:

$P_f = acos[d/(v*handoff\ delay)] /asin\ [a/(2*d)]$ (4)

Here, $P_t$ = Transmitted power of system
d= Distance between MS and BT of system
$d_0$= Reference distance from BT
n= Path loss exponent
v= velocity of MS
a= coverage area radius of system

### 3.3. Parameters Setting

***Table 1. Input data***

| **Parameters** | **Values** |
|---|---|
| LTE frequency | 2.3 GHz |
| WLAN frequency | 2.4 GHz |
| LTE _transmit power | 33 dBm |
| WLAN transmit power | 26 dBm |
| Mobile station speed | 20 m/s |
| LTE point | 0 |
| WLAN point | 600 |
| Mobile station point | 100 |
| n (LTE) | 3.7 |
| n (WLAN) | 2.7 |
| a (LTE) | 1000 m |
| a (WLAN) | 100 m |
| $d_o$ | 10 m |
| Sample time | 0.5 s |

## IV. SIMULATION RESULTS

Fig.3 shows the RSS value of the both network. From that, the current RSS value of both network and the threshold RSS value are calculated as from the algorithm the decision can be taken and this is shown in the fig.4. The state of MS in network as shown in figure 4 the MS initially in the LTE network shows the network of mark at one. After the handoff the MS handed over to WLAN and that time the mark of the network is zero. When WLAN coverage area is over at that time MS back to the LTE coverage area due to the force handover.

 

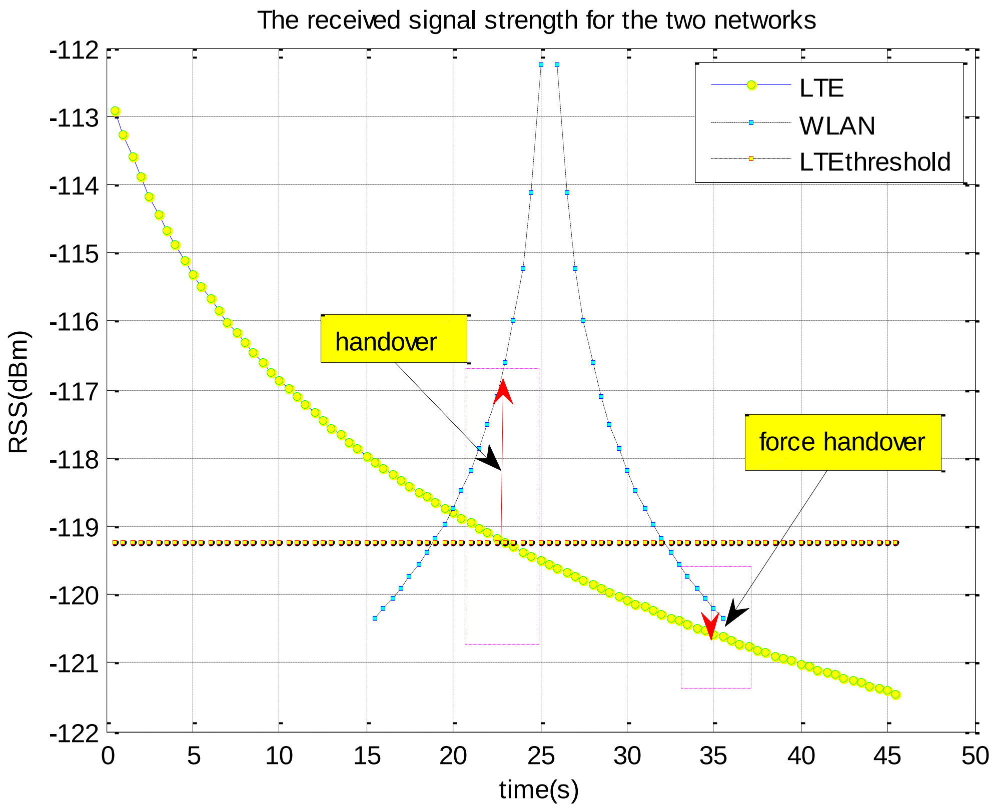


*Figure 3. Current RSS value of both the network*

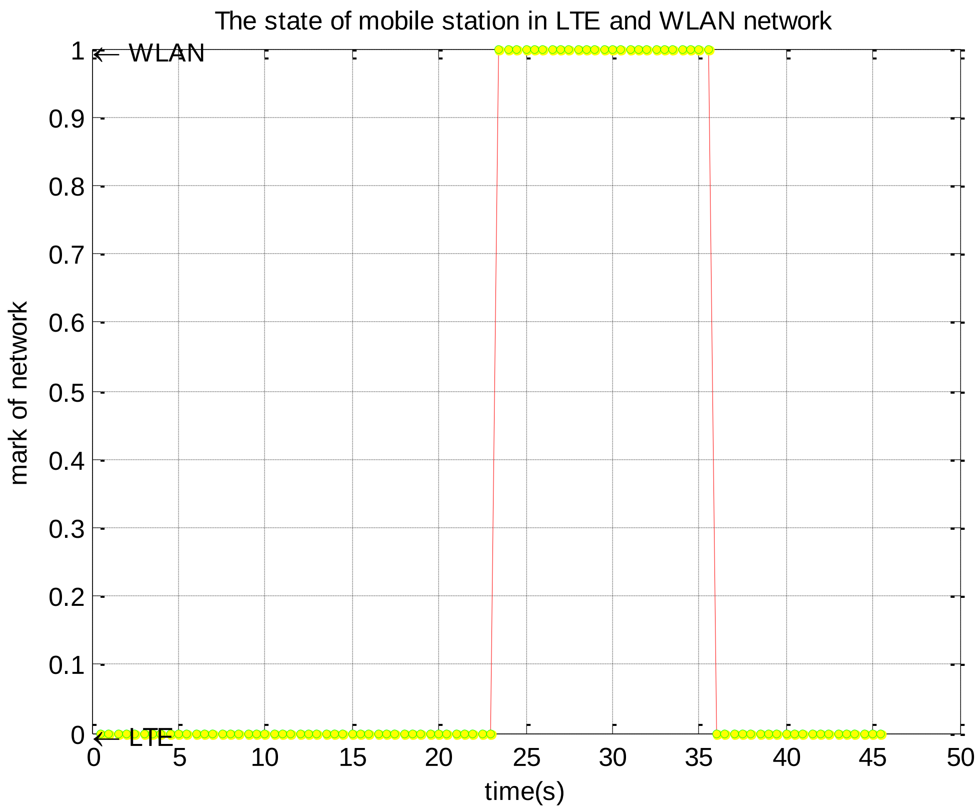


*Figure 4. State of mobile station*

 

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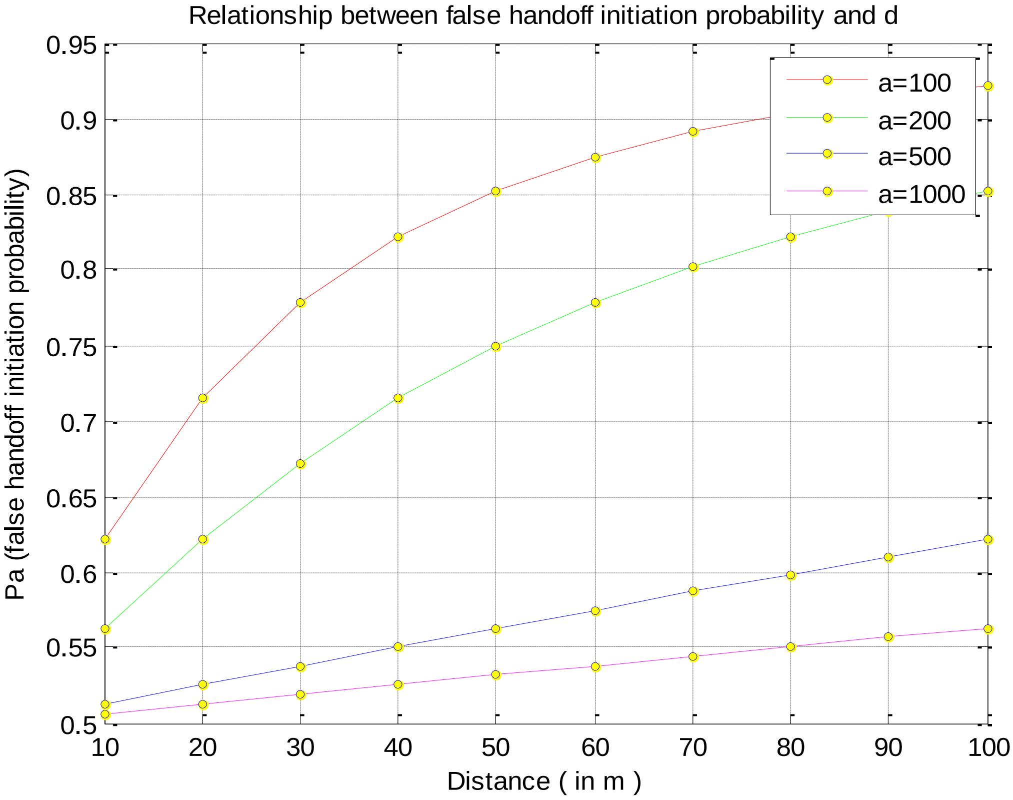


***Figure 5. Relationship between false handoff initiation probability and distance***

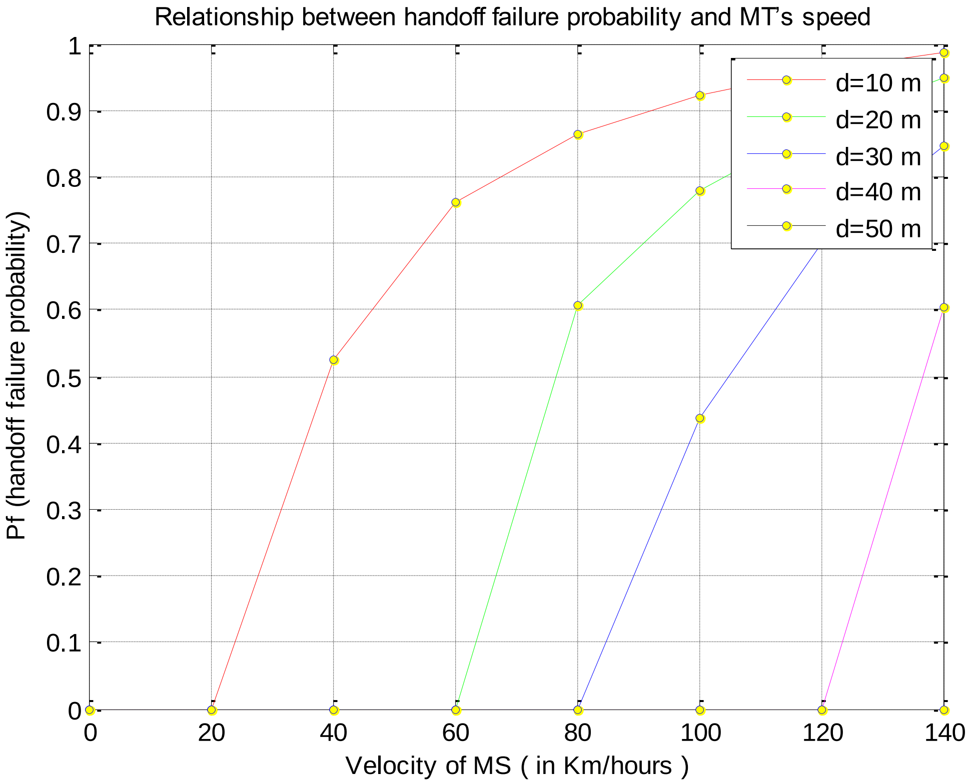


***Figure 6. Relationship between handoff failure probability and speed***

 

It is clear from figure 5 that, if an unnecessarily large value for d (hence, the corresponding value of $RSS_{th}$ is used for handoff initiation, the probability of false handoff initiation increases. This results in the wastage of limited wireless system resources. Moreover, this increases the load on the network that arises because of the handoff initiation. The relationship between probability of false handoff initiation and d is shown in Fig. 5 for different cell sizes, a. Fig.5 shows that, for a particular value of a, the probability of false handoff $RSS_{th}$ initiation increases as d increases. It also shows that the problem of false handoff initiation becomes more and more severe when the cell size decreases. The cell size of wireless systems is decreasing so that the capacity and data rate may increase.

Equation 4 shows that, if a fixed value of $RSS_{th}$ (hence, a fixed value of corresponding d) is used, the handoff failure probability depends on the speed of the MT. The probability of handoff failure $P_f$, increases when MT's speed increases. The relationship between $P_f$ and MT's speed is shown in Fig.6 for intersystem handoff. This figure show the numerical value of $P_f$ for different values of d (corresponding to different values of $RSS_{th}$). We considered a cell size of 100 m for this simulation. The latency of intersystem handoff is significantly larger than that of intra system handoff because, during an intersystem handoff before registration, authentication and billing procedures are carried out, adding extra delay to the handoff process. Moreover, the intersystem signalling messages are handled by MT's home agent (HA) instead of gateway foreign agent (GFA), adding extra delay to the signal propagation as the distance of MT from HA is typically larger than that of MT from the BT. We considered handoff latency 3 sec for intersystem handoff procedures. Fig.6 shows that, for a particular value of d, as speed increases, the handoff failure probability increases for both intersystem handoffs. This is because, as speed increases, on average, the MT requires less time to cross the coverage region of OBS. These figures also show that, when a particular value of $RSS_{th}$ this used, $P_f$ becomes higher for intersystem handoff compared to intra system handoff for a different speed. To summarize, this analysis shows that the value of d and, therefore, the value of $RSS_{th}$, should be adaptive to the speed of the MT and to the type of handoff to guarantee a desired handoff failure probability.

## V. CONCLUSION

In this work, first give the small introduction about the handoff in the next-generation wireless systems. Then, we analyse the performance of handoff algorithm that use a fixed value of RSS threshold (RSSth) to initiate the handoff process. Through our analysis, we observe that, at starting when MS is in LTE and stats journey from LTE BS and moving towards WLAN network at this condition current RSS is continuously decreases. When current RSS below the threshold RSS and same time RSS of WLAN network is higher than the RSS threshold at that time connection transfer to the WLAN. It is clear from result that, if an unnecessarily large value for d (hence, the corresponding value of $RSS_{th}$ is used for handoff initiation, the probability of false handoff initiation increases. This results in the wastage of limited wireless system resources. Moreover, this increases the load on the network that arises because of the handoff initiation. The handoff failure probability depends on the speed of the MT. The probability of handoff failure $P_f$, increases when MT's speed increases. Result show that, for a particular value of d, as speed increases, the handoff failure probability increases for both intersystem handoff. This is because, as speed increases, on average, the MT requires less time to cross the coverage region of OBS.

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