

## Design an Algorithm for Vertical Handover In Heterogeneous Network

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### ABSTRACT

A heterogeneous network is consisting of different wireless access standards. For seamless data transfer a vertical handoff (VHO) plays a major role. Vertical Handoff decision (VHO) is totally based upon Received Signal Strength (RSS) measurements. Handoff (HO) decision is made individually without considering other HO user equipments (UE). User mobility is a factor, which having important role in VHO decision. VHO is required only at lower speeds and high speed user velocity may cause unnecessary handovers that can degrade system capacity and QoS level. UE velocity make a HO decision, we can reduce the transmission cost and transmission time. Because of high bandwidth and ease of networking we consider the wireless access standards: Wi-Fi and Wi-max and LTE system. The algorithm is simulated in NS2 and the performance of the network is evaluated in terms of user velocity and handover numbers.

**Keywords** - Heterogeneous wireless network(HWN), Vertical Handoff(VHO), Horizontal Handoff(HHO)

### I. INTRODUCTION

A mobile moves into a different cell, at that time a conversation is in progress, the MSC automatically transfers the call to a new channel belonging to the new base station referred to as handoff (HO).HO can be classified into:

- Vertical HO
- Horizontal HO

The handoff between access networks with different link layer technologies is defined as vertical handoff (VHO) whereas handoff between different access points within the same link layer technology is defined as horizontal handoff (HHO) [5].The considerations for vertical handover include:

- considered for accurate HO prediction. A mobile
- The VHO supported device must contain a mobile node remain connected to the dual card that enables connection between different wireless standards.
- Various handover metrics are considered to decide the wireless standard that can support handoff efficiently.

The different metrics includes:

- Receiving signal strength(RSS)
- User velocity
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In order to achieve seamless vertical mobility it is essential to consider the mobility pattern of the user which can be obtained from the LTE System. Received

node chooses an access point (AP) which offers maximum signal strength. HO is initiated when the corresponding RSS from an AP falls below a threshold value due to the various fading effects. The RSS threshold is fixed based on mobile node (MN) location and velocity information. Thus the combination of mobility pattern and RSS reduces the unnecessary handoffs. The main reasons for unnecessary HOs are: [2], [3]

- Network congestion.
- Unable to identify temporary coverage.
- Scarcity of required resources.

Among these problems, identifying the temporary coverage is one of the main problems faced by the heterogeneous network. That means the

temporary

signal strength (RSS) is a parameter which is to be coverage network at least for a minimum amount of time called HO recovery period. If a VHO occur before HO recovery period, all the optimal resources and favorable network conditions provided by the new network for establishing the new connection does not get successfully utilized. This will also cause large signalling overhead and delay.

Monetary cost, offered services, network conditions and user preferences are the other additional factors considered besides RSS and user velocity. This paper considers the influence of other users requesting HO, i.e., considering the collision among different users when they try to access the

same APs or base station. This will degrade the This paper considers the influence of other users requesting HO, i.e., considering the collision among different users when they try to access the same APs or base station. This will degrade the overall network performance due to higher congestion delays and dropped call probability. So, in order to improve the performance of the heterogeneous network an objective function is developed which considers all the above mentioned parameters and through the optimization of this objective function system performance can be improved. The new VHO scheme involves two steps: [1]

- Picking HO candidates: It is purely based on the parameters such as RSS, velocity and user type.
- Optimization of objective function: The objective function comprises different factors which the network operators concern, for e.g.: load, cost, battery life time etc. This paper considers mainly the parameters load and cost and generalizes the objective function.

Due to ever growing demand for packet-based mobile broadband systems, the 3GPP [11] has introduced LTE (Long Term Evolution) specifications [14] as the next step of the current 3.5G cellular networks. An enhanced access network (i.e., the E-UTRAN, Evolved-UMTS Terrestrial Radio Access Network) and an evolved core network have been defined[12].

*Overview of Wimax and Wi-Fi and LTE System*

In this paper we consider the network that integrates both Wimax and Wi-Fi and LTE access standards. The Wimax and WiFi are considered due to their high bandwidth availability and ease of networking.

- *Wimax*: The Wimax is a wireless Ethernet standard (802.16). It provides wide range of user mobility and It is accessible everywhere. The operation of Wimax is same as that of Wi-Fi, but Wimax can operate at higher speed. Also the coverage area of Wimax is large therefore it can support large number of users. The coverage area is about 400m at 3.5GHz with a data rate of 20Mbps [10].
- *Wi-Fi*: A well developed wireless technology of present day which uses high frequency radio signals for data transmission. Wi-Fi(802.11) operates in 2.4GHz band with a data rate of 11Mbps and a coverage area of about 70-80meters.It can also operate in the 5GHz band which offers a maximum data rate of 54Mbps and uses OFDM based air interface[10].
- *LTE*: The LTE radio access is based on Orthogonal Frequency Division Multiplexing (OFDM) and provides a highly flexible

bandwidth (from 1.4 to 20 Mhz). Both frequency division duplex (FDD) and time-division duplex (TDD) multiple access techniques are supported [14]. Radio resources are distributed among users in a time-frequency domain. The eNB schedules radio resources among uplink/downlink flows at the beginning of each sub-frame. LTE-Sim supports all six channel bandwidths (i.e., 1.4, 3, 5, 10, 15, and 20 MHz) available for the LTE system and the cellular frequency reuse.

**II. System Description**

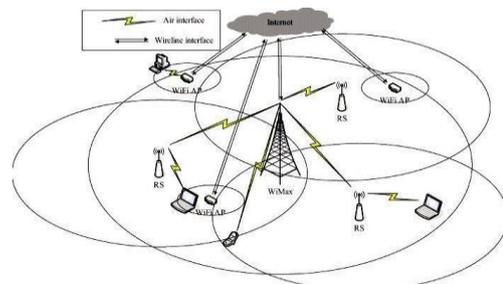


Fig.1. System Description

We consider a heterogeneous network with Wimax and Wi-Fi as the sub networks with one Wimax BS and three Wi-Fi APs. The number of BS is always selected as one except in the case of highly dense urban environment. The number of user equipment in the particular network is assumed as ten.

Figure1 is the grammatical representation of the simulation model. The inner circle with larger radius represents the Wimax service range and the other three circles with equal radius represent the Wi-Fi service range.

**III. Vertical Handoff Algorithm (Vho)**

The VHO scheme is explained using flow chart as given below [1].

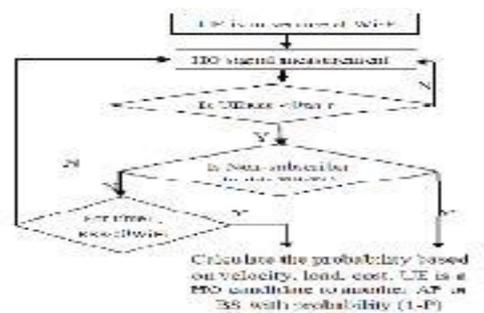


Fig. 2. Flowchart for picking HO candidates in Wi-Fi

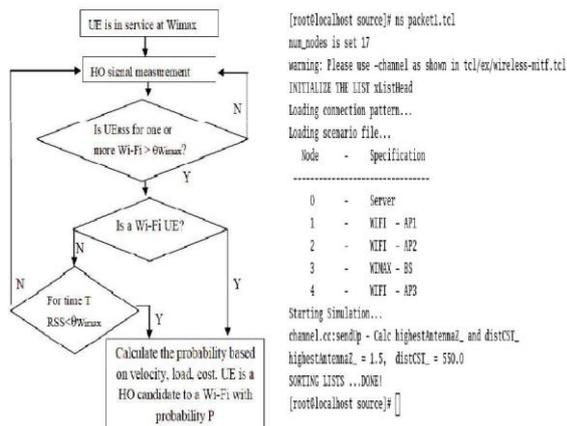


Fig.3.Flowchart for picking HO candidates in Wimax

As shown in the flowchart, a UE requesting HO can either belongs to a BS or an AP. For a UE in service at a BS, HO may occur if the RSS from one or more AP exceeds a specific threshold, say Wimax or it may also happens when in service at an AP, the User Equipment RSS falls below a threshold them it is called as Wi-Fi. If the above conditions satisfy, then the network checks whether the UE is its subscriber or not. This is done to ensure QoS of the subscribers, i.e., the subscriber belongs to a particular BS or AP gets a higher priority than the non-subscribers. This is achieved by introducing a time duration T, such that if the HO requesting UE is under the service of corresponding network(a subscriber), the UE can remain in the network for a time duration T till  $RSS < (Wi-Fi \text{ or } Wimax)$ . If the HO requesting UE is a non-subscriber to the current network, then the network immediately performs HO and releases the resources for the subscribers. To avoid the unnecessary HO, probability of HO is measured by considering some parameters such as velocity of the UE, maximum load that a particular network can tolerate. For a high speed UE, the probability of remaining in the BS is high, if the other constraints such as bandwidth availability and service cost offered by the network also satisfy.

#### IV. ESTABLISHED NODES

For the simulation purpose, there are 17 nodes, which are divided into following specifications. There are nodes from 0 to 17, where 0 node defines Server, node 1,2,4 defines nodes of Wi-Fi, node 3 define node of Wi-Max and Remaining nodes as a mobile users.

#### V. Network Performance Evaluation RESULTS ANALYSIS

##### Performance Evaluation

The performance of the network is evaluated by following scenarios:

- i. WiFi+WiMax
- ii. Wi-Fi+WiMax+LTE
- iii. WiFi
- iv. WiMax
- v.LTE

A network is considered that is covered by one BS and three APs. Remaining users are distributed in the network and are assigned velocities in the range. The threshold is set, The Wimax range is set to be 500m and the Wifi range is set in the range [200m 400m] and their corresponding frequencies are 5GHz and 2.5GHz respectively. The maximum tolerable system bandwidth is assigned.

##### Results analysis

In the following scenario, HO prediction is made based on the parameters RSS and velocity. In the second scenario we propose a new VHO scheme considering an optimized objective function along with RSS and velocity. For that we are considering Wi-Fi Network or WiMax Network or LTE Network. The following result obtained.

- i. Call Dropping
- ii. Comparison delay
- iii. Performance under Diff. Packet Loss
- iv. Overall packet delivery ratio
- v. Overall throughput

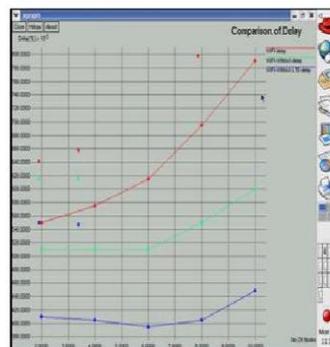


Fig.4. Comparison of Delay Wi-Fi, Wimax, LTE



Fig.5. Call drop probability Wi-Fi, WiMAX, LTE



Fig.6. Overall Packet Delivery Ratio



Fig.7. Overall Throughput

## VI. Conclusions

In this paper an open source framework to simulate LTE networks, namely *LTE-Sim*, has been proposed. Features covered by this simulator will allow both researchers and practitioners to test enhanced techniques for improving 4G cellular networks, such as new physical functionalities, innovative network protocols and architectures, high performance scheduling strategies, and so on. The open nature of this software can allow people interested in research in this field to contribute to the development of the framework, furnishing a

reference platform for testing and comparing new solution for LTE systems. Effectiveness of the developed simulator has been verified with several simulations to study the scalability and the performance of the framework. Such as the Wi-Fi, WiMAX and LTE comparatively represented in above graphical representation.

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