

A Review on Research Aspects of Vertical Handover Decision based Intelligent Algorithm

Shelej Khara¹, Dr. Sajjan Singh², Dr. S. V. A. V Prasad³

Research Scholar, Dept of ECE, Lingaya's University, Faridabad, Haryana, India¹

Asst. Professor, Dept of ECE ECE, BRCM College of Engineering & Technology, Bahal, Bhiwani, Haryana, India²

Professor- Dept of ECE, Lingaya's University, Faridabad, Haryana, India³

ABSTRACT: Fourth-Generation (4G) wireless networks will be heterogeneous, integrating different networks to provide seamless internet access for mobile users with multi mode access capability. The Fourth Generation of communications systems is all about a global wireless communications system and defines a cost effective, simple, operable and personalized according to the users' needs concept. The vertical handoff requirements are potential of the network, network cost, handoff latency, network conditions, power consumption and user's preference. These must be taken into consideration during vertical handoff. In this research paper survey of different research aspects of vertical handover decision (VHD) based intelligent algorithm is done. A refined, intelligent Associative Rule Mining (ARM) and Artificial Intelligence (AI) based approach is required to implement the vertical handoff intelligent mechanism in fourth generation wireless networks to produce an effective service for the user by considering non dynamic and dynamic parameters.

KEYWORDS: 4G, Vertical Handover decision (VHD), ARM, AI

I. INTRODUCTION

These days in 4G wireless communications, it is necessary to provide flawless mobility to maintain across heterogeneous access networks. The benefit of heterogeneous network is that, devices can connect to different wireless networks without interruption of service while the network is being switched [1]. The problem in heterogeneous environments due to incompatibility problems transition between diverse types of access technologies can lead to reduced performance. Flawless mobility can be achieved by enabling mobile terminals to conduct seamless handovers across diverse access networks [2, 3].

In these days mobile terminals are equipped with multiple wireless interfaces to access Internet services through different access technologies such as Wi-Max, Wi-Fi, 3GPP, 3GPP2. since the media types are incompatible these wireless interfaces does not provide mechanisms to handoff across heterogeneous networks. Mobility can be attained by handoff mechanism in wireless networks. Handoff or Handover is the process of maintaining user's active session when a mobile terminal changes its point of attachment. Depending on point of attachment

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the handoff can be either horizontal handoff (HHO) or vertical handoff takes place between point of attachment supporting the same network technology e.g. between two neighboring base stations. Vertical handoff (VHO) takes place between points of attachment sustaining different network technologies [4, 10]. The main distinction between VHO and HHO is symmetry. While HHO is a symmetric process, VHO is an asymmetric process in which the MT moves between two different networks with different characteristics. In Figure 1.1 shown that the process of vertical handoff and horizontal handoff.

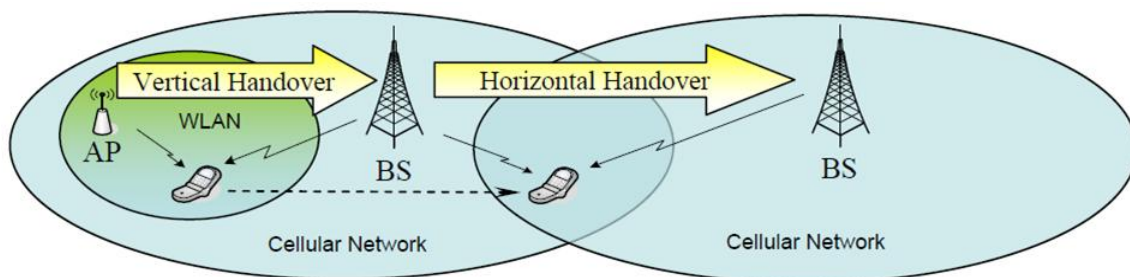


Figure 1.1 Procedure of Vertical Handoff [10]

II. OVERVIEW OF VERTICAL HANDOFF PROCESS

Vertical handover is the process of keeping a user's active communication when a mobile terminal changes its connection point to the access network. A handover process can be split into various stages which are as follows: handover Initiation, handover decision and handover Execution [5,6].

- **Handover Initiation:** It involves the selection of the target point of attachment, depending upon certain parameters and the time of the handover.
- **Handover Decision:** It is the task of creating links to the new point of attachment.
- **Handover Execution:** In this process new channel is allotted. VHD algorithms are helpful in the way that they help mobile terminals to choose the best network to connect to among all the available channels.

A. Vertical Handoff Decision (VHD) Criteria

Several parameters have been proposed for use in the VHD algorithms. We briefly explain each of them below [7,8,9]. Figure 2.1 shows various parameters.

- i. **Received signal strength (RSS):** It is the main criteria for VHD. The RSS can be easily measured and service quality is directly related to it. It is mostly used in horizontal handover algorithms [11].
- ii. **Network connection time:** The network connection time is most important. It refers to the duration that a mobile terminal remains connected to a point of attachment.
- iii. **Available bandwidth:** It is a measure of available data communication resources expressed in bit/s.
- iv. **Power consumption:** When mobile terminal's battery is low the power consumption becomes critical issue.
- v. **Monetary cost:** In some conditions the cost of a network service should be taken into consideration in making handover decisions as every network has its own charging policies.

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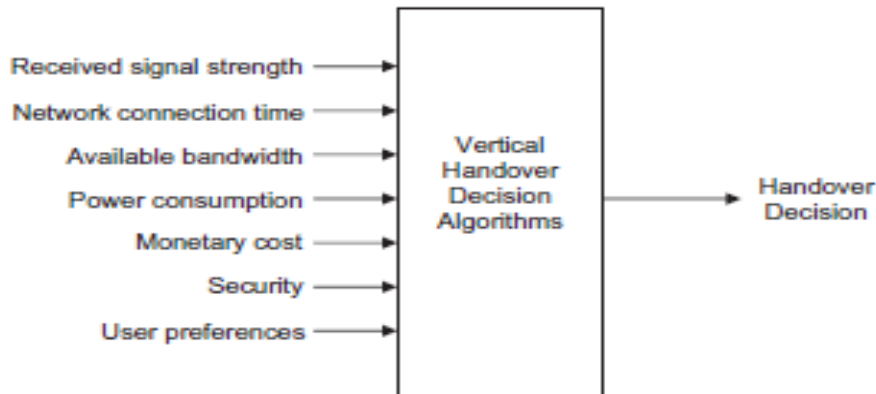


Figure 2.1 VHD parameters

- vi. **Security:** A network with higher security level may be chosen over another one which would provide lower level of data security when integrity of the transmitted data can be critical.
- vii. **User preferences:** In some cases a user's personal preference towards an access network could lead to the selection of one type of network over the other candidates.

III. CLASSIFICATION OF VHD ALGORITHM

A. RSS Based VHD Algorithms:

The RSS based algorithms Received Signal Strength is the most important criteria. VHD algorithms evaluate the RSS of the current connection against the others to make handover decisions [12]. Figure 3.1 show the basic handoff procedure. Here we describe the method using following two conditions.

In the first condition, when the mobile terminal moves from the coverage area of a WLAN into a third generation, a handover to the third generation network start. When the average of RSS of WLAN connection falls below predefined threshold, and the predictable lifetime is less than or equal to the handover delay, the handover is triggered.

In the second condition when the mobile terminal moves towards a WLAN cell, the handover to the WLAN is triggered if the average RSS capacity of the WLAN signal is larger than a threshold and the available bandwidth of the WLAN meets the bandwidth requirements of the application.

When a mobile terminal is connected to a WLAN access point an algorithm is proposed, between WLAN and 3G which is based on comparison of the dynamic RSS and a current RSS threshold. This is useful in the way that it reduces the incidences of false handover and limits the handover failures. The unnecessary handovers introduced in the above method are removed by travelling distance prediction based algorithm. This algorithm considers the stay time the mobile terminal within the cell [13]. A handover to a WLAN is triggered if the WLAN coverage is available and the predictable traveling time inside the WLAN cell is larger than the time threshold.

The main benefit of this method is that it minimizes handover failures, unnecessary handovers and connection breakdowns however handover delay is increased.

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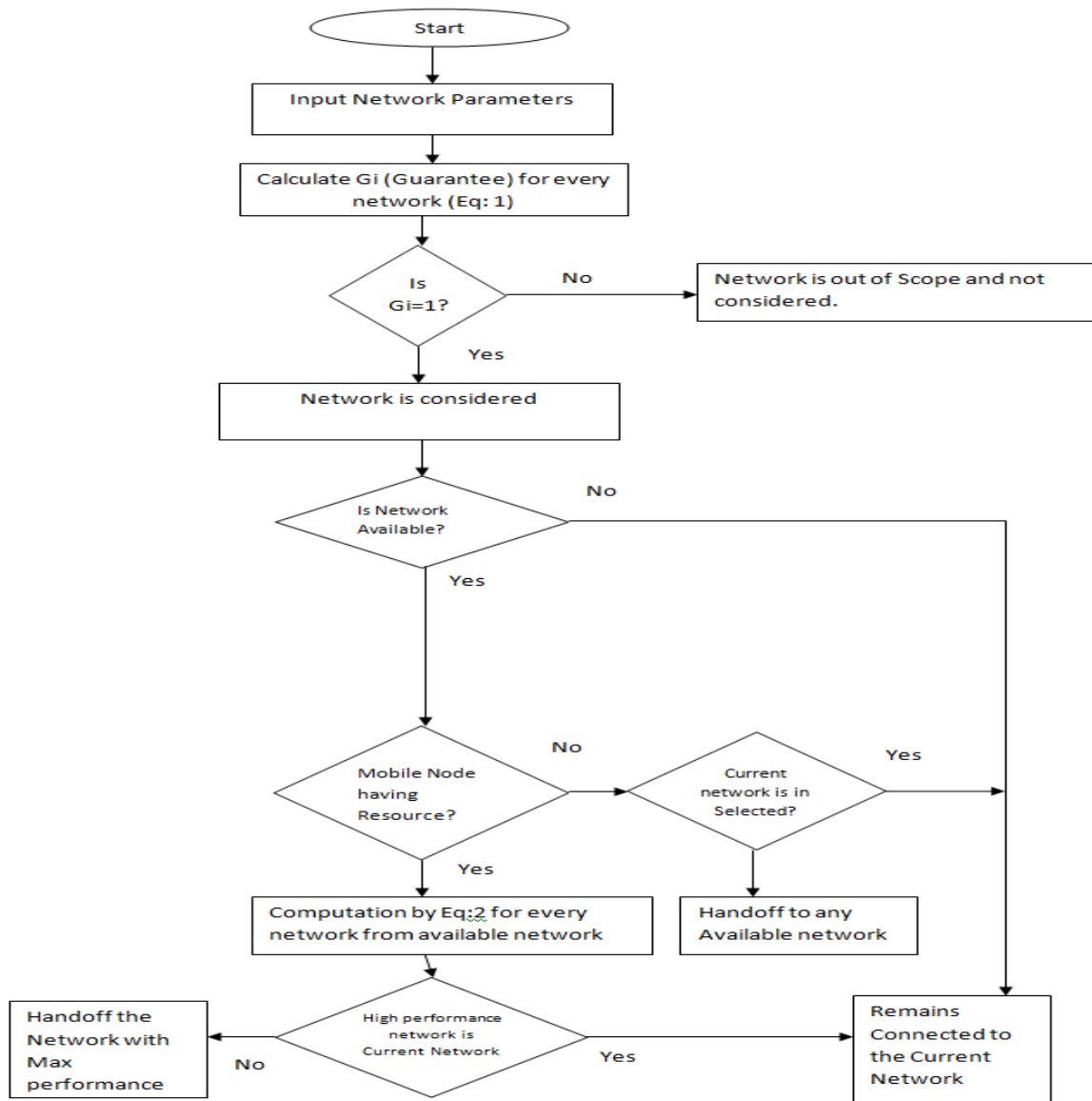


Figure 3.1 Flow chart for Handoff

B. Bandwidth Based VHD Algorithms:

Bandwidth is the main criteria in this algorithm for the handover.

An algorithm is proposed, which takes remaining bandwidth and user service requirements into account in deciding whether to handover from a WLAN to Wireless Wide Area Network (WWAN) and vice versa[14]. The algorithm also takes the position of the mobile terminal into consideration.

A handover to the preferred access network is performed if the mobile terminal is in the idle state. As the available bandwidth is considered as the main criteria it gives good throughput for VHD. Lower handover latency for delay-sensitive applications is achieved by taking application types into account. To improve the overall system throughput an algorithm is developed between WLAN and Wideband Code

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(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 8, August 2015

Division Multiple Access (WCDMA), considers the Signal to Interference and Noise Ratio (SINR). The SINR calculation of the WLAN signals is transformed to an equivalent SINR for comparison with the SINR of the WCDMA channel.

This provides the user's higher throughput than RSS based handovers since the available throughput is directly dependent on the SINR. However these algorithms may also introduce ping-pong effect.

C. Cost Function Based VHD Algorithms:

The cost function based vertical handoff decision algorithm chooses a combination of network and DE factors such as RSS, , available bandwidth, service cost, network covering area, security, battery power and DE mobility model and define a cost function based on these factors to estimate the performance of target networks. The handoff decision can then be made accordingly.

In this method priority of all the active applications is taken and then cost of each possible target network for the service with the maximum priority is calculated. This method is useful due to the use of cost function, as the percentage of user fulfilled requests is increased and handover blocking probability is reduced. The normalization and weights distribution methods are provided in cost function based handover decision algorithm. The network candidate with the highest weight function is selected as the handover target. The benefit of this method is handover decision delay is reduced, high throughput and low handover blocking rate.

D. Hybrid Algorithm:

A hybrid algorithm uses various parameters in the handover decision. Artificial neural networks (ANN) or fuzzy logic is used in these algorithms. The features of available wireless networks are collected by mobile devices and are sent to a middleware called vertical handover manager through the obtainable links [15]. The vertical handover manager consists of three main components: network handling manager, feature collector and ANN training/selector. A multilayer feed forward ANN is used to determine the best handover target wireless network available to the mobile device, based on the user's preferences.

Unnecessary handovers and ping-pong effect is avoided in this algorithm.

E. Drawback of Existing Algorithm:

The existing methods have the some drawbacks. In some research methods they are not considered the nearest base station congestion while the call is transferred to the nearest base station. If handover does not occur at right time the QoS may be drop below an adequate level and connection will be dropped. The queuing method has been introduced in handover to prioritize the calls based on the FIFO scheme. Although, this queuing method also has the drawback that if the call reaches the receiver threshold and no free channel if found then the call is terminated. So there is a need to develop a new handover technique in the cellular network

F. Proposed Algorithm

The proposed handoff decision algorithm uses a historical intelligence prediction data to perform the successful handoff decision. The historical intelligence prediction data have the information of all networks in a particular coverage area; the information will be the address of the network in which the mobile terminal is currently connected, the available bandwidth and the average delay provided by all the available networks in the area. In addition to this, the congestion data will be considered and analyzed. The proposed algorithm consists of an association rule mining (ARM) algorithm and an artificial intelligence (AI) technique. The ARM algorithm uses an intelligence prediction data, and generates interesting rules based on the network details and the congestion. The obtained rules will be given to the AI technique for training. The handoff decision will be based on the AI output that is obtained at runtime. The usage of AI technique in the handoff decision process will reduce the computation complexity which already exists in the conventional methods.

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Table 3.1 Analysis of VHD Algorithm

S. No.	Algorithms	Parameter	Features	Benefits	Drawback
1	RSS Based Travelling Distance Prediction Based	Dynamic time threshold	A dynamic times threshold is calculated and compared with the predicted travelling time to determine the handover.	-Handover failures and unnecessary handovers are reduced.	Extra handover delay
2	Bandwidth Based WDP Based	Probability of unnecessary and missing handovers	Available bandwidth, network coverage and probability of missing handovers are considered to determine handover	Reduced WDP -balance of the traffic load	-increased connection breakdown
3	Cost Function Based Weighted Function Based	Weighted function of network	Weighted function is used and handover is delegated to visited network instead of mobile terminal	-Resource of the mobile can be saved -low handover delay -low handover blocking rate -high throughput	-require extra coordination between MT and point of attachment
4	Hybrid Fuzzy logic based	RSS, Bandwidth	FNQD is used to calculate the PEVs of the networks	-Reduces the number of unnecessary handovers -Avoid the pingpong effect	-Fixed weights are assigned to the inputs while calculating the PEVs
5	Proposed Algorithm Based ARM & AI Technique	Bandwidth, Cost, Time Delay ,Congestion	The ARM algorithm uses an intelligence prediction data, and generates interesting rules based on the network details and the congestion	Reduce complexity, Time Delay, Reduce the no. of unnecessary handover	Increased Cost

IV. CONCLUSION

In RSS based algorithms the RSS is the main parameter. The RSS based algorithms are the simplest algorithms. The RSS is combined with bandwidth in bandwidth based algorithms, these algorithms are also easy. In terms of complexity the cost function based, Hybrid, and proposed ARM & AI based algorithm are more complex as more parameters are taken into consideration. Hybrid algorithms use various parameters to determine the target network for handover helping to select the best available network as per the user's preferences. ARM & AI based algorithms provide security also reductions is delay, packet loss and reduce complexity. So the computational power of handsets should be improved to implement several VHD algorithms in a handset and adopt adaptive methods that choose an algorithm intelligently based on conditions and user preferences.

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Vol. 4, Issue 8, August 2015

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