

# **A Vertical Handoff Decision in Next Generation Wireless Networks with aid of ARM and AI Techniques**

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**ABSTRACT:** Fourth-Generation (4G) wireless networks will be heterogeneous, integrating different networks to provide continuous access for mobile users with multi mode access capability. The Fourth Generation 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 considered during vertical handoff. In this research paper a new vertical handoff decision based on ARM & AI Techniques is designed. A refined, intelligent Associative Rule Mining (ARM) and Artificial Intelligence (AI) based technique is used to execute the vertical handoff intelligent mechanism in fourth generation wireless networks to produce an effective service which reduces the handoff delay and complexity.

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

## **1. INTRODUCTION**

Wireless networking is becoming a progressively more important and accepted method of transferring global information access to users while they are moving. Existing technologies vary broadly in various parameters such as bandwidths, latencies, frequencies, and media access methods. In spite of this variation, most existing wireless network technologies can be broadly divided into two types: those that over a wide geographic area provide a low-bandwidth service and those over a narrow geographic area provide a high bandwidth service. While it is required to provide a high-bandwidth service to mobile users at all times, this is not likely.[3,12] Wireless local area networks only give small coverage, and a mobile host cannot exploit existing high-bandwidth infrastructure equipped only with a wide-area network. No single wireless network technology concurrently provides high bandwidth, wide-area data service, a low-latency to large number of mobile users. Our solution is to use a various combination of wireless networks to provide the best promising coverage over a wide range of geographic areas. A mobile device with multiple wireless network interfaces has many ways of accessing the wired infrastructure through alternative wireless subnets.

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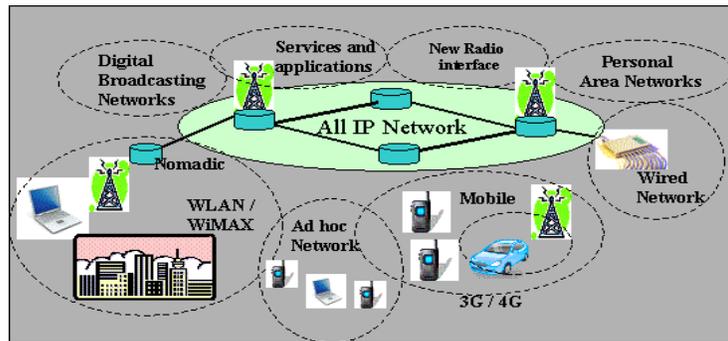


Figure 1: Types of Network

## II OVERVIEW OF VERTICAL HANDOFF PROCESS

Vertical handover is the method of maintenance of a user's active communication when a mobile terminal changes from 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 considers the selection of the target point of connection, depending upon certain parameters and the time of the handover.[1,10]
- **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 in this the best network is connected among all the available channels.

### II.1 Vertical Handoff Decision (VHD) Criteria

Several parameters have been considered for use in the VHD algorithms. We explain Each of them below [7, 8, 9].

- 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 essential. It refers to the extent that a user remains connected to the current point of connection.
- iii. **Available bandwidth:** It is a calculation of existing data communication resources and is expressed in bit/s. [2,12]
- iv. **Power consumption:** The power consumption becomes critical issue when the battery of mobile terminal is low [6,20]
- v. **Monetary cost:** In some cases the cost of a network service must be considered in making handover decisions as every network has its own charging policies.[4,18]
- vi. **Security:** A network with advanced security level may be selected over another one which would offer lower level of data security when integrity of the transmitted data can be vital.
- vii. **User preferences:** In some cases a user's individual liking could lead to the selection of one type of network over the other networks.[5,13]

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## III. CLASSIFICATION OF VHD ALGORITHM:

### *III.I RSS Based VHD Algorithms:*

The RSS based algorithms have received Signal Strength as the most important criteria. VHD algorithms evaluate the RSS of the current connection against the others to make handover decisions [12]. Here we describe the method using following two conditions.

In the first situation, when the mobile terminal moves from the exposure area of a WLAN into a third generation, a handover to the third generation network start. The handover is triggered.

When the average of RSS of WLAN connection falls below predefined threshold, and the expected lifetime is less than or equal to the handover delay,

In the other condition the handover to the WLAN is triggered when the mobile terminal moves to a WLAN cell, 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.

An algorithm is proposed, between WLAN and 3G which is based on comparison of the dynamic RSS and a current RSS threshold, when a mobile terminal is connected to a WLAN access point this is useful in the way that it reduces the cases of false handover and confines the handover failure. The unnecessary handovers introduced in the above method are removed by travelling distance calculation based algorithm. This algorithm considers the stay time the mobile terminal within the cell [13]. If the WLAN coverage is available and the predictable traveling time inside the WLAN cell is larger than the time threshold handover to a WLAN is triggered

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

### *III.II Bandwidth Based VHD Algorithms:*

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

In this algorithm remaining bandwidth and user service requirements are considered in deciding whether to handover from a WLAN to Wireless Wide Area Network (WWAN) and vice versa[14]. The position of the mobile terminal is also considered. .

If the mobile terminal is in the idle state a handover to the preferred access network is performed, It gives good throughput for VHD As the available bandwidth is considered as the main criteria. For delay-sensitive applications Lower handover latency is achieved . To improve the overall system throughput an algorithm is developed between WLAN and Wideband Code 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.

Since the available throughput is directly dependent on the SINR this provides the user's higher throughput than RSS based handovers .However ping-pong effect may be introduced by these algorithms.

### *III.III Cost Function Based VHD Algorithms:*

The cost function based vertical handoff decision algorithm chooses a combination of network and other factors such as RSS, available bandwidth, service cost, network covering area, security, battery power to estimate the work performance of target networks. Accordingly the handoff decision can then be made. In this method cost of each possible target network is calculated according to priority. This method is useful due to the use of cost function. It reduces the handover blocking probability and increases percentage of user fulfilled requests. In cost function based handover decision algorithm the normalization and weights distribution methods are provided the network which has the highest weight function is selected as the handover target. It has the benefit of reduced handover decision delay high throughput and low handover blocking rate. [5, 19]

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### ***III.IV 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]. It consists of three main components: network handling manager, feature collector and ANN training/selector. The best handover target wireless network available to the mobile device is decided by a multilayer feed forward ANN, based on the user's preferences. [6, 20] Superfluous handovers and ping-pong effect is avoided in this algorithm.

### ***III.V Drawback of Existing Algorithm:***

The existing methods have the some drawbacks. In some research methods they have not considered the nearest base station congestion while the call is transferred to the nearest base station. The QoS may drop below an adequate level and connection will be dropped If handover does not occur at right time .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 even if after the call reaches the receiver threshold and no free channel is found then the call is terminated. So there is a need to develop a new handover technique in the cellular network

## **IV METHODOLOGY**

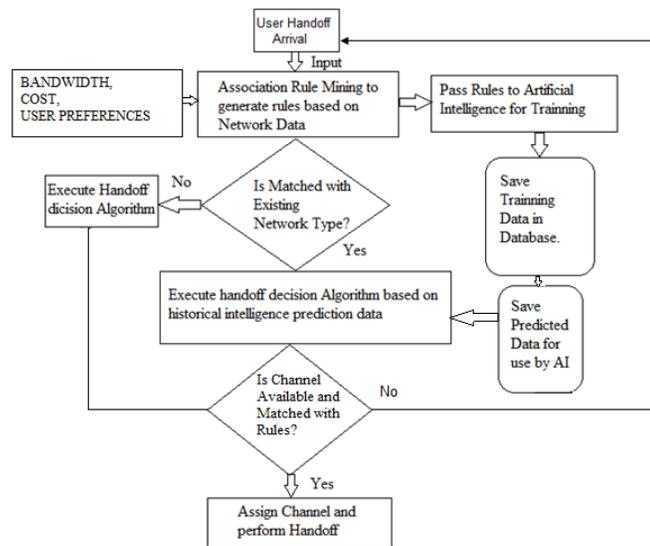
In this work, the proposed work has intended to propose a new vertical handoff decision algorithm, which has overcome the aforesaid drawbacks that are present in the existing methods. The proposed handoff decision algorithm uses a historical intelligence prediction data to perform the successful handoff 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. The proposed handoff decision algorithm will be implemented in working platform of MATLAB and the performance will be analyzed.

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## V BLOCK DIAGRAM



## VI OBJECTIVES AND CHALLENGES

There are number of problems in the handoff initiation and decision process. The main Challenges in realizing these objectives include in the design of a flawless vertical handoff system are:

- To generate the Historical Data based on the Network Configuration.
- To handoff the Mobile Nodes using Artificial Intelligence based on historical information.
- To implement Rule Mining and generate the handoff factor, handoff rules based on Bandwidth, RSS and Cost in terms of time.
- Selection of best possible target network using competent decision making algorithm.
- Execute the necessary handoffs in Vertical Communication.
- Power Savings: reduce the power drain by keeping vertical handoff decision simple.
- Bandwidth Overhead: reduce the amount of extra network traffic used to implement handoffs by achieving most favorable network.
- To measure the improvement gained by handing off to a particular network an extended vertical handoff decision function is developed.

## VII MEAN HANDOFF COMPUTATION ALGORITHM

Algorithm is used for solving the problem step by step which can be implemented with help of programming in any language.

- Start
- Setup the Input Parameters BW, Time and RSS (Signal Strength).
- Setup the Fuzzy Inference System based on Input parameters with Membership Functions
- Adjust and Initialize the Membership Functions value with variation of High, Low and Medium range.
- Setup Output parameter as result with Range of High, Low and Medium using Triangular Function.

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6. Generate the Different Rules based on Input Parameters and Set the Handoff Factor with getting of Threshold Values.
7. Input the Number of Nodes/Users 1,2...up to N.
8. Input the Threshold Values by the Step 6 such as  $b_i$ ,  $RSS_i$  and  $C_i$
9. Enter the other networks detail and Current Connected Network.
10. Train the Network with Input Values.
11. If Exist, Get Historical Information and Perform Decision based on the Network Conditions, Exit.
12. Else Perform Decision Function and Allocate the Network, Saved for Future Training.
13. Exit

### VIII FUZZY RULES SET

The different sets of rules can be defined with the different combinations such as Signal Strength, Bandwidth and Time. Depending upon the one value, the other values and rules would vary. These combinations have been defined in the table and can be used in the Fuzzy Logic editor.

Table 1: Rules Definitions

Rules	RSS	BW	Time
1	Low	Low	Low
2	Low	Low	Medium
3	Low	Low	High
4	Low	Medium	Low
5	Low	Medium	Medium
6	Low	Medium	High
7	Low	High	Low
8	Low	High	Medium
9	Low	High	High
10	Medium	Low	Low
11	Medium	Low	Medium
12	Medium	Low	High
13	Medium	Medium	Low
14	Medium	Medium	Medium
15	Medium	Medium	High
16	Medium	High	Low

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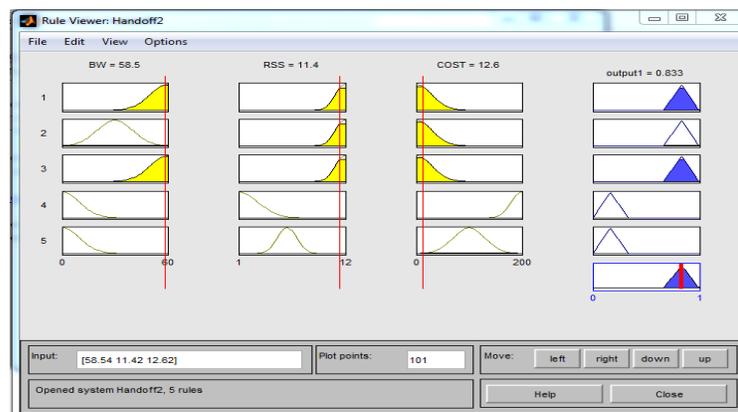
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17	Medium	High	Medium
18	Medium	High	High
19	High	Low	Low
20	High	Low	Medium
21	High	Low	High
22	High	Medium	Low
23	High	Medium	Medium
24	High	Medium	High
25	High	High	Low
26	High	High	Medium
27	High	High	High

## IX CASE STUDIES ON THE PROPOSED SYSTEM

The number of experiments has been implemented on the proposed system with variation of the rules and handoff factor

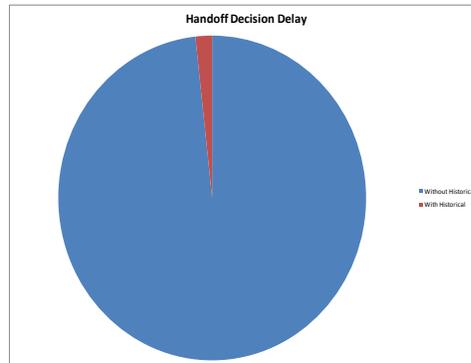


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## X RESULTS



## XI CONCLUSION

In this research, we have offered a vertical handoff scheme in mobile communication environment. The existing system has reduced the unnecessary handoffs. The number of network parameters has been considered initially. To reduce the unnecessary time delay an efficient vertical handover mechanism for wireless networks handoffs is designed based on the historical information and the rules generated using fuzzy system. The time duration of handoff is fast and its delay is reduced. Number of handoff is minimized, which avoids deprivation in signal quality and supplementary loads of the network. Handoff latency during handoff is reduced. The enhanced and competent result has been generated. Handoff algorithm is easy and has less computational complication.

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