

Adaptive Data Rate Oriented Speed and Capacity Based Vertical Handoff Algorithm

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Abstract: *In wireless cellular environment the handoff algorithm determine when the handoff will occur and at which base station. Heterogeneous network such as UMTS, WLAN, WiMax where vertical hand off is required further challenges the cellular network. This paper provides an adaptive multiple attribute vertical hand of algorithm which allows wireless networks to select a mobile terminal using fuzzy logic concept. The main contribution of this paper is to propose adaptive data rate oriented speed and capacity based vertical hand of schemes which not only considers velocity, signal strength but also considers network bandwidth utilization for achieving load balancing named as adaptive data rate adjustment. This enables the user in achieving quality of service in heterogeneous network and provides free moving experience. A performance study using heterogeneous network such UMTS, WLAN, WiMax, as example shows that our proposed vertical hand off algorithm is able to determine when the hand off is required and selects the best access network that is optimized to network conditions , quality of service requirement , user preference , service cost , mobile terminal conditions .*

Keywords: Vertical handoff, heterogeneous wireless network, adaptive data rate, mobile terminal

1. INTRODUCTION

Wireless Heterogeneous network such as WiMax, (World Wide Interoperability for Microwave Access), WLAN (Wireless Local Area Network), UMTS (Universal Mobile Telecommunication System) have different characteristic based on velocity, bandwidth, load, cost etc. There is an incessant increase in demand to support roaming between heterogeneous network to provide better quality of service and provide user with free moving experience.

Handoff refers to the process of transferring an ongoing call from one channel connected to another network. The main purpose of handoff is to avoid call termination when the phone is moving away from the area covered by one cell and entering the area covered by another cell. There are two types of handoff vertical handoff and horizontal handoff. Vertical Handoff is used to support mobility. Vertical handoff is automatic fall over from one technology to another in order to maintain mobility. Horizontal Handoff is quite different from vertical handoff. Horizontal Handoff takes place between two cells of same network. For e.g. a user moving from UMTS cell to another UMTS cell is an example of horizontal handoff. Vertical Handoff not only provides free movement of user but also helps in achieving desired QOS.

In this paper, we propose Adaptive data rate oriented speed and capacity based vertical handoff schemes. The main contribution of this paper is based on traditional strategy of using RSS (Received Signal Strength) combined with other network

parameters such as node velocity, bandwidth utilization, and signal strength and user preference. The incorporation of network parameters considering process in vertical hand off matrix, to potentially reduce packet loss and provide mobility adaption in hand off calculation and optimization of proposed hand off function considering user preference. In adaptive data rate the mobile node adapts itself according to the requirement of base station in other terms (Load Balancing). Compared to traditional system there was load unbalancing due to unaware network bandwidth utilization/data rate. The traditional system lacks quality of service routing. If the bandwidth of the mobile node is greater than that of the other network it reduces its data rate according to the requirement of the other network. This is known as Adaptive Data Rate. The proposed system provides better load balancing minimizes packet loss during hand off mechanism and tolerant hand off delay even for high speed mobile terminal.

The simulation result which show the advantage of the proposed algorithm. The rest of the paper is divided into following sections: Section II describes the related work of existing vertical hand off system algorithms. In section III Adaptive Data Rate speed and capacity based vertical hand off algorithm is explained in detail. The simulation results are described in section IV. In section V we have concluded this paper.

2. RELATED WORK

Vertical hand off decision is triggered when there is availability of new point of attachment or unavailability of old point of attachment is detected. Vertical hand off algorithm is of vital importance for heterogeneous network. In [1] the author has proposed a Smart Decision Model to decide “Best” network interface and “best” time moment to perform hand off. A score function is utilized in the model to make the smart decision based on various factors such as properties of available network interface, system information and user preference. In [2] the author has described that Vertical handoff occurs when a user changes association from one type of wireless access technology to another while maintain an active session. Much work has been done in ensuring seamless handoff that prevents Quality of Service. In [3] the author has proposed Vertical Handoff in Fourth Generation Multi Network Environment. In this the author has developed new technologies for dynamic handoff and context aware radio link transfer. It allows user to move seamlessly within a network while receiving a context aware services. In [4] the author has proposed Optimization for Vertical Handoff Decision Algorithms. It has enabled access to different technologies in this firstly the author has discussed the concept of policy based handoff. Secondly cost function is used to calculate target network based on variety of user and network valued metrics. Lastly the performance Analysis is used to find out the significant gain in QOS and the resources can be used efficiently from proposed optimization. The proposed optimization has reduced operators cost and delay. In [5] the author has proposed adaptive hard hand off algorithms which is based on optimizing the trade of between quality of link and rate of hand off is taken into account. Adaption means to remain on locus of desirable operating point as system parameters such as velocity changes. The main advantage of adaptive hard hand off algorithm is that it reduces hand off cost and delay. In [6] the author has proposed a pattern recognition system for hand off algorithm. In this the author has introduced a new algorithm to overcome the problem of traditional hand off algorithm and to meet the challenges by using microcellular systems. The new algorithm uses statistical pattern recognition technique and make use of radio wave prorogation which was not used by Traditional Hand off algorithm. The main advantage of this algorithm is that it has reduced hand off cost, has prevented unnecessary hand off and has accuracy trade off. In [7] the author has proposed a multi service vertical hand off decision algorithm. In this the author has described policy based hand off approach and has introduced MUSE-BDA Multiservice Vertical Hand off decision algorithm for a cost function based vertical hand off decision algorithm. This network has the ability to satisfy all the users’ simultaneous request. The main advantage of this algorithm is that it satisfies user’s requirement and avoid unnecessary hand off.

3. ADAPTIVE DATA RATE ORIENTED VERTICAL HANDOFF ALGORITHM

Our proposed algorithm can be divided into five parts (1) Velocity Analysis, (2) Bandwidth Analysis and Adaptive Data Rate Adjustment, (3) Fuzzy Logic, (4) Handoff Execution and Decision Making, (5) Performance Evaluation

A. Block Diagram

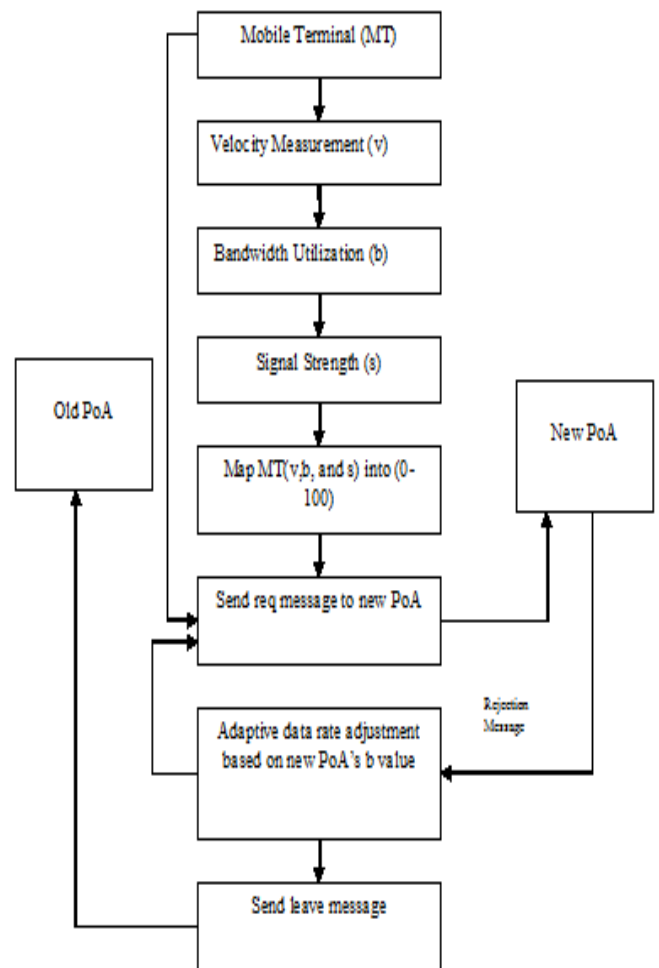


Figure 1: Block Diagram

B. Architecture Diagram

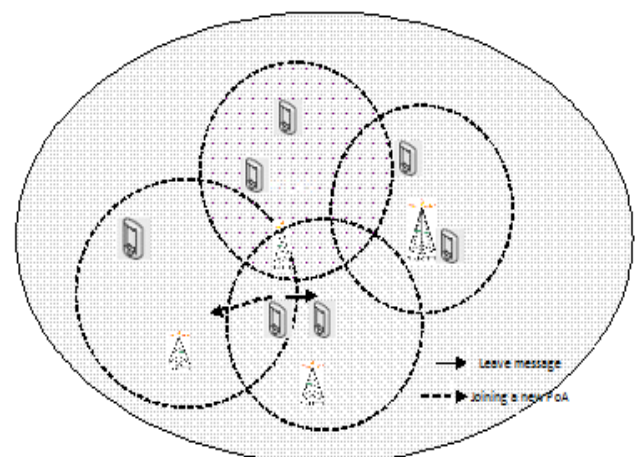


Figure 2: Architecture Diagram

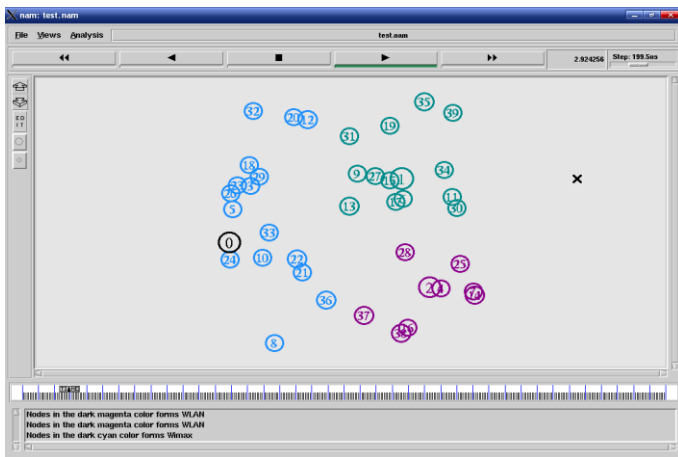


Figure 3: Network Model

3.1. Velocity Analysis

The system Model consist of three types of network namely WLAN, WiMax and UMTS. L11 link denotes WLAN network, L16 link represents WiMax network and UMTS link stands for UMTS network. Whenever any input information is given to Mobile Terminal, it first checks its velocity and the type of link. The Mobile Terminal should select a proper network according to speed as different networks have different coverage. Three different velocity thresholds are defined for each type of network. Coverage is directly proportional to the velocity threshold of network. Velocity is mapped based on their threshold ranging from 1 to 100. Moreover it employs a ratio variable to denote the velocity value.

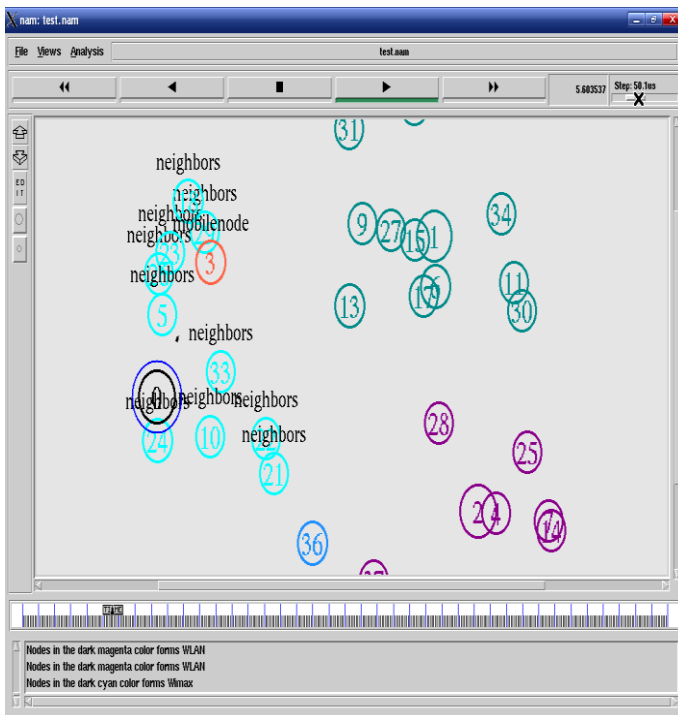


Figure 4: Base station of UMTS network is Node 0, now the Mobile node selected in the network and it connected with the Base station 0

3.2. Bandwidth Analysis and Adaptive Data Rate Adjustment

When a Mobile Terminal gets the input information it will first check the link types and its bandwidth utilization. Since different networks vary in coverage, the mobile terminal need to choose a proper network which suits its bandwidth and define three threshold of bandwidth each for a specific type of network. In general smaller the coverage higher will be its bandwidth utilization node threshold the network will get. Bandwidth utilization is mapped from number ranging 1 to 100. According to these thresholds. It employs capacity variable to denote the bandwidth value. If it is not suited for a new point of attachment, it adjusts the data rate before sending the request message to new point of attachment.

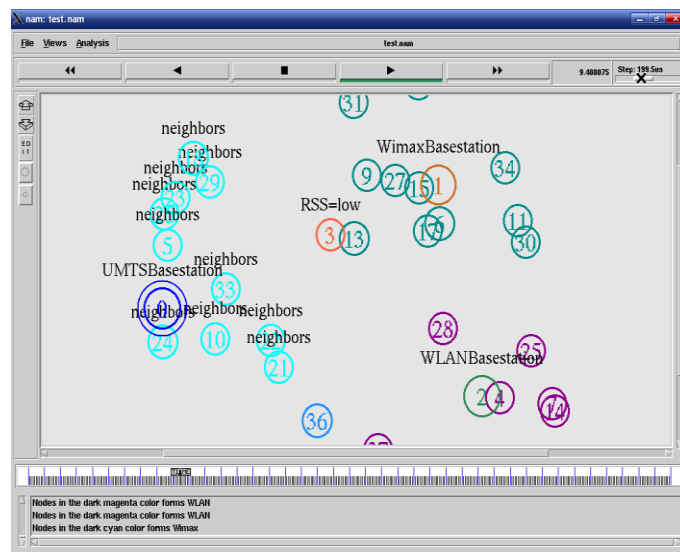


Figure 5: After getting mobility it will loss the RSS, now it will search for the any other network to offer the requirement of the mobile node

3.3. Fuzzy Control

A fuzzy control system is a control system based on fuzzy logic – a mathematical system which takes continuous values between 0 and 1 in contrast to digital logic which operates on discrete values of either 0 or 1. Fuzzy logic reasoning which is approximate rather than fixed or exact value. It is necessary to transform information into fuzzy sets. In this section we have considered two parameters (a) Received Signal Strength (b) Load Conditions of Candidate network. Received power threshold is denoted by Prx. If received signal strength is stronger than Prx, the packet will successfully be received. The RSS is mapped in the values ranging from weak, medium, strong. Access Point will determine the load conditions ranging from 0 – 100. 0 means the link is not used by any user and 100 means link does not have any resource. One of the important parameter is user preference. When user preference is mapped as high it means a new link is being preferred by user, when user preference is mapped as low it means that user are not in a mood to perform handoff unless current link is becoming down.

3.4. Handoff Decision and Handoff Execution

In handoff decision the transformation of input set is performed

into fuzzy set. Sometimes handoff decision is also taken based on IF-THEN rules. The last step of this algorithm is to perform handoff execution. The new point of attachment will receive request from mobile terminal. After receiving the request from the mobile terminal the point of attachment will reserve resource and send acknowledgment. A new connection is being set by a mobile terminal after receiving the acknowledgment with the new link. The mobile terminal will now send the message of its leaving to the old point of attachment. The old point of attachment will now release the occupied resource and the link will be disconnected. In this way a connection is being established by mobile terminal to new network. In this way vertical handoff is being performed.

4. PERFORMANCE METRICS & RESULTS

Performance of the proposed approach is calculated based on these matrices:

4.1. Handoff Time: It is the time difference between which a handoff request is made and the time between which the handoff is successfully completed.

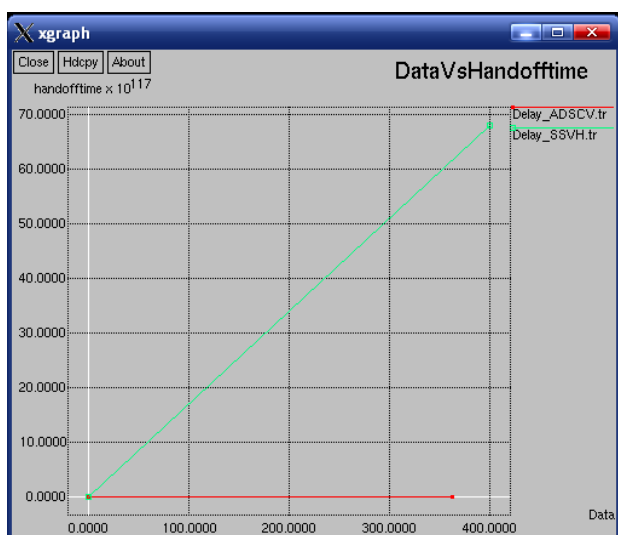


Figure 6: Handoff time comparison of the existing and proposed system

Compare to the proposed system the handoff time of the existing system is high. In the existing system the packet transfer does not consider bandwidth, but the proposed system considers the bandwidth while perform handoff.

4.2. Throughput: It is the time taken for a data to reach the destination Mobile Terminal from source node Mobile Terminal.

$$\text{Throughput} = \frac{\sum(\text{Delay of each entities data Packet})}{\text{Total Number of delivered data packets}}$$

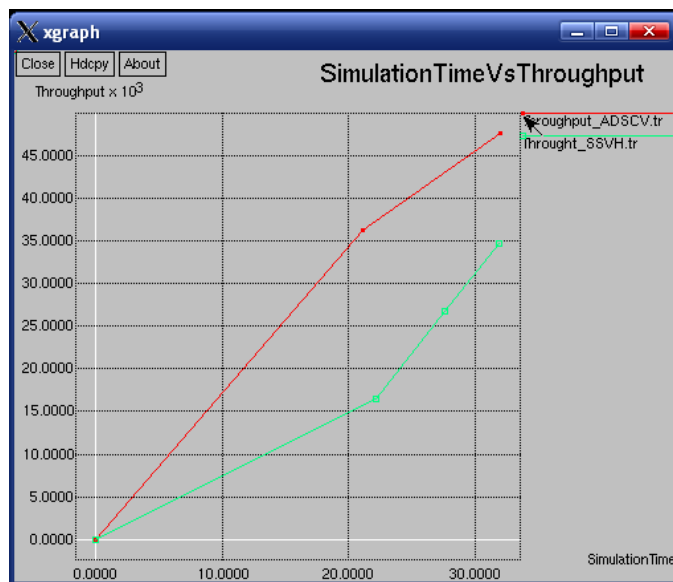


Figure 7: Throughput comparison of the existing and proposed system

Because the proposed system considers the bandwidth during the handoff, so throughput of the proposed system increases while increasing the simulation time.

5. CONCLUSION

Vertical handoff is very important to heterogeneous networks. A suitable handoff algorithm can lower handoff times and improve handoff efficiency. We propose a speed sensitive handoff algorithm based on fuzzy control in this paper. It considers velocity, received signal strength, load condition, and user preference as metrics of the network selection factors. In addition to, it includes adaptive data rate adjustment on considering the bandwidth utilization. The simulation results show that the new algorithm such as speed and bandwidth utilization based vertical handover algorithm ensures better destination network than the traditional RSS based handoff algorithm and improves the handoff efficiency when the users are moving at a high speed. When considering actual user preference and network capacity, the proposed handoff algorithm gives better performance, packet loss control, as well as reducing unnecessary handoff times.

6. FUTURE WORK

If handoff is done without considering the direction of mobility of the MT, it will cause the frequent handoff between cellular networks. In future, Handoff decision should be done by considering the mobility direction of the MT to avoid the problem mentioned above. Hence request for handoff should also contain the direction of the MT.

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