The Relationship between Received Signal Strength and velocity in 4G Heterogeneous network

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Abstract

The fourth generation of wireless communication systems is the 4G networks, and they follow the 3G networks that were in use. Actually, a 4G network connects the customers even on the road at high speeds and enables them to send and receive information. Approved by the International Telecommunication Union (ITU), 4G technology boasts many capabilities such as high-speed data transfer much faster than that of 3G technology, and smooth handoff between base stations which use IP packets over the network.

Keywords

1. Introduction

Today, the most popular mobile communication systems are 4G, and deciding which network is best can be determined on the basis of two factors, the statics and the dynamic factors. The network's bandwidth, how much power the network consumes, the usage charger, and the device's battery level are the static factors. Nonetheless, the Dynamic factors search for the hand off by computing the optimal time to connect with network during "Received Signal Strength" (RSS). RSS helps to improve the performance of the communication system according to current user conditions; for instance, the traveling speed of mobile hosts may knock out some networks which cannot handle mobility. Handoff means transferring a mobile from one base station to the other as the user moves between cells. A traditional communication system employs "hard handoff" or "break-beforemake" where the connection to the current cell is broken first, followed by a connection to the next cell. Nevertheless, 4G networks work differently where the connection to the new cell can be made prior to breaking away from the previous cell. This is what they called "make-beforebreak" or Soft handoff, which has reduced the interference and increased the capacity for the network because it requires less power. The key concept behind the soft handoff in the 4G networks is to guarantee connectivity at the old base station upon the new base station taking control of the communication link and to make certain the call activity is not severed. We know that the 4G network uses the soft handoff and there's also a difference in types of handoff such as vertical and horizontal. [7] Among the most difficult challenges of the heterogeneous network is the integration of existing with future wireless network, and supporting transparent vertical handoff free from degrading the Quality of Services (QoS) between network discovery (NA) and the Received Signal Strength (RSS) within the heterogeneous network [1,2]. In the heterogeneous network, RSS is not enough for a vertical handoff as it is not possible to compare the RSS from different networks directly. Moreover, all the networks have different RSS factors, and network conditions can't be reflected by RSS. As reported by Q. Song as well as A. Jamalipour, it is necessary for the RSS to employ the conjunction so as to effect the vertical handoff [3,5]. Important factors for the VHO are RSS with a mobile station velocity and movement pattern because it adjusts well in time, adaptively and predicts the residual time.

Literature Review:

Some articles have been written on (VHO) beyond the (HHO) methods. The reports give three basic approaches to VHO: using RSS combined with network loading, using artificial intelligence and camping several parameters like the conditions of the mobile terminal and network. Or the static factors can be used, taking into account things like what the available access network is, how much power is consumed, the bandwidth, and the network's cost access. Wang and colleagues advanced the policy enabled Handoff, which was followed by a number of papers on parallel methods [6]. Policy empowered handoff systems detach the decision making (i.e. what network is the best and when is it right to do a handoff from that mechanism?) Those systems let users adopt policies on which is the best wireless system at any instant and make compromises among network characteristics and dynamics like cost, performance and power usage. The decision strategy picks the best network according to the strongest received signal strength and weakest variation of received signal strength. Through the reduction of unnecessary handoffs, high quality performance is ensured. Nonetheless, at any time there is a high quality connection between base station and user, we will decrease unnecessary handoffs by transmitting the RSS at high-speed. Here in the project we'll note additional algorithms that are related such as the traditional, the fuzzy handoff, and the ANFIS handoff algorithms. A handoff that's vertical -- As the user moves between cells, the connection is made between mobile and base station. A

horizontal handoff is the connection that is made between the mobile and another network rather than the base station. Figure 1 will demonstrate how we have accomplished the vertical and horizontal handoff. In a network that is 4G heterogeneous -- In this scenario, there is no question on how the intra-technology (HHO) functions in the mobile terminal hand-off between three base stations(BS) or two points(AP), but the inter-technology (VHO) associated with the MT uses different access technology. The (VHO) supports two movements; one is moving out of the desired network Upward Vertical Handover, and the other is moving into the desired network Downward Vertical Handover. [2] Becoming the key of developing the 4G network, when the HHO proser between to access point (AP) or two base station (BS), the (VHO) is proses between two (MT) Multi Technology access instead the base station, Both intra-technology handoff or horizontal handoff (HHO) and inter-technology or Vertical Handoff (VHO) took place.

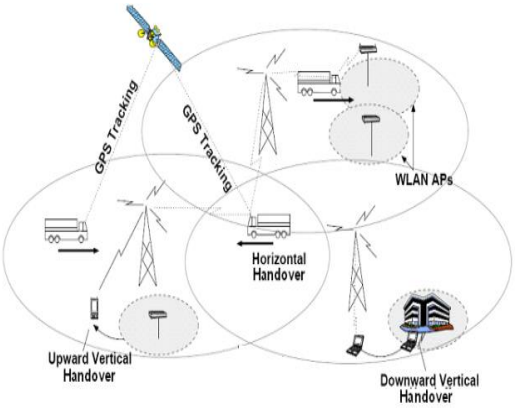

Fig.1, Horizontal and vertical handoff for heterogeneous network

Which factors need to be present to help us choose a handoff within the heterogeneous networks? The biggest consideration for the user is what the provider charges, but if there is a choice of rate plans they can choose the network and handoff decision that is best. The highest bandwidth that the network offers will give the highest quality service, meaning that there's high-speed flow data and less call dropping. Wireless equipment operates on limited battery power, so another important requirement when choosing a network is the power consideration. Long usage time happens as that level decreases. A heterogeneous network is made to have a small cell area that lets users more easily access the cell so that they get high quality service. When the user traveling back to the previous cell it will be discouraged because they need to establish the connection again (i.e. the Handoff in the CDMA network takes 7m/s to be done) so that is cause overlaid, on the other hand. Signal strength plays a big role regarding the candidate's attachment point in the HHO (traditional handoff). In vertical Handoff VHO, though, it is not valid to compare the RSS because of the asymmetrical behavior of VHO. That means that when more than one candidate network is discovered, the MT needs to select the strongest RSS. [3] Moreover, I will use adaptive RSS algorithm to obtain quality service and to decrease needless handoff. Thres_serving: the value of RSS, crossing below which will trigger the handoff process.

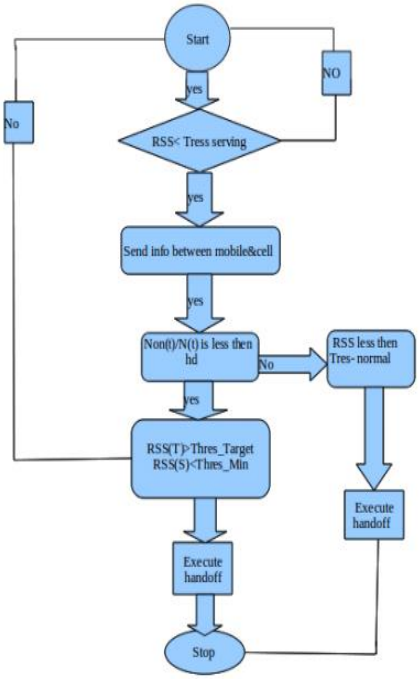

Fig. 2, adaptive algorithm

The tres_min tells the least value of RSS that will allow there to be successful communication between the MT and TS. Thres_target: the value of the RSS at the target station to achieve handoff. N (T): it represents the volume of the traffic load. N (on): the number of users inside the cell during On mode. The N (hold) means the amount of uses that can be accessed while in the hold mode. HD: how valuable the hot spot status is. As the number of mobile nodes increase, the traffic load is taken as 1, but the value of traffic load is approximated at 0 when the current cell is regarded as the lightly loaded cell. The cell at hand then turns into the hot-spot. The hot-spot threshold refers to the (hd) value that the algorithm uses. If the ratio of number of available resources over number of total resources is below (hd), then the cell has hotspot condition. Figure 2 layers out the Adaptive RSS algorithm. As Figure 1 indicates, when the RSS of the serving cell is below the threshold value, it transmits the load data request message to the destination cell and receives load data response message from that cell. In (1) we see that the traffic load is calculated by the target cell. Should the amount of the target's available resources be less than the hotspot threshold, the serving cell will send an alarm to the target cell until that cell finishes all the handover requests that are still pending. At that point, handover is carried out at target station (TS). As this algorithm has been proposed, the right threshold value needs to be chosen wisely so that the quality of service other

users get isn't degraded. Initiation of the handoff procedure used fixed RSS in previous implementations. It's advised that there be set an adaptive RSS threshold in order for the mobile to have sufficient time to start the handoff process. A mathematical formula called the adaptive RSS threshold that controls handoff time is applied to modify the algorithm. Three states can be found between the mobile and the base station using the RSS adaptive algorithm:

1. On state is the active mode where the client's down link and up link are totally connected with the base station.
2. Hold state when the down link is full but up link is empty, in this instance it is regarded as an active mode
3. The presumption is that handoff mode is ON since after it's over the load of traffic can be calculated by adding up the amount of users in three modes of ON, HOLD, and Handoff

$$NT = NON + NHO + ß\ NHOLD \quad \textbf{.....2}$$

Where:

NT represents the value of the traffic loads, NON represents the number of users under the ON state, NHOLD represents the number of users under the HOLD state, and NHO represents the number of handoff calls. ß is an adaptive factor and the volume of traffic load ranges between 0 and 1. An adaptive RSS algorithm uses the data message to note the neighbor cell's load status. The algorithm contains an equation which controls the handoff time and thres_min depending on the cell's load status.

$$pf = a \cos (d/vJ) /a \tan (a/2d).....3$$

$$pa = 1 - (1p) * 1.....4$$

Where:

$$1 \text{ is equal a } \tan (a/2d)……5$$

Calculating the probability of handoff failure or initiation has to do with

a. the cell's size
b. how far it is between the mobile and the base station
c. how fast the mobile movement is v. [7]

2. Simulation

so that the adaptive RSS algorithm can be checked out in the heterogeneous network using the java language. In the scenario will be showing a possible scene consisting of a GSM network, a CDMA network, and WLAN. To examine a heterogeneous network system in which two cellular systems GSM & CDMA and a WLAN produce an overlay arrangement, as indicated in Fig. Sixth: The cell boundaries of all networks can be moved through an MT (mobile terminal) that has triple network interfaces.

The simulation is designed to include the 3 possibilities where the mobile terminal MT can reside in any one of the regions among A, B, and C at any point of time and is able to access the networks: If the MT resides in:

Region A – can access only CDMA network.

Every WLAN, CDMA, and GSM network is able to be accessed through Region B From Region C only the GSM network can be accessed.

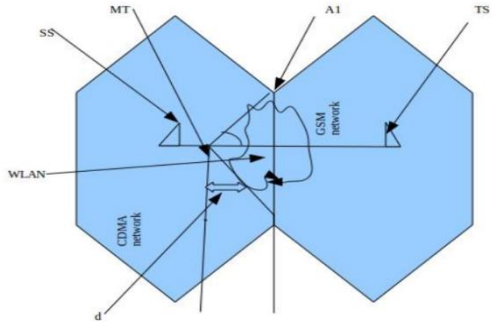

Fig.3, Analysis of probability of handoff failure & initiation as mobile moves from Ss to Ts via WLAN

Mobile's speed and handover signaling delay can be computed via mathematical equations number 3, 4 and 5 to control the handover time and thres_min depending on the load condition of cells. The result is then obtained with the relationship between the RSS velocity and distance. Applying the parameters and values in Table 1 to the equations by using Java language

Table 1 Applying the parameters with selective values by using Java language in mathematical equations

Parameters	Values
Cell radius(a)	1Km
Maximum speed of Mobile(V)	100km
Distances(d)	0 to 1000m
Path-loss coefficient, α	4
Minimum value of RSS(min)	-64 dBm
Handoff signal delay J	1,3
Standard deviation of shadow fading, ε	8

Thres_min increases as mobile speed increases for the particular value, which is the relation between Thres_min and distance of the mobile.

3. Results and Discussion

That's because for a slow speed MT there should be a later handoff initiation in comparison to a high speed mobile terminal and with regard to the relationship between velocity and probability of handoff failure, the failure rate will depend on how fast the mobile terminal is. As the speed of MT goes up, the probability of handoff failing (pf) goes up. In Figure (6) we see how (pf) and MT's speed relate to each other. As evident, for a given value of d, as the value

of (v) goes up,(pf) goes up for system handoff.

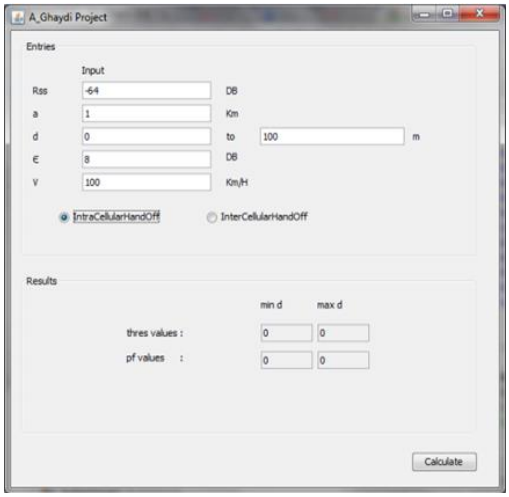

Fig. 4, Data values in mathematical equations

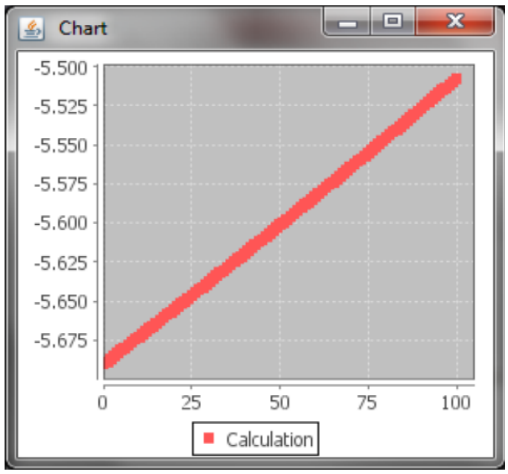

Fig.5, Relationship of velocity and RSS

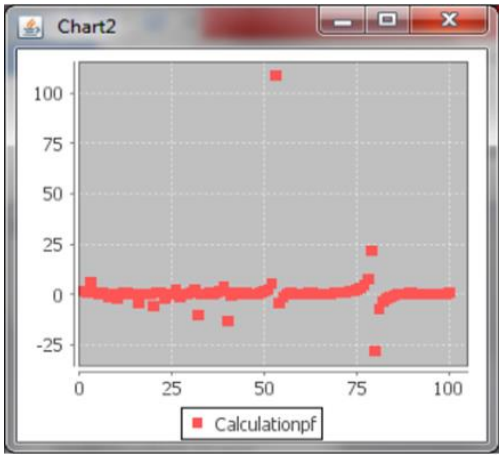

Fig.6, Relationship of velocity and pf

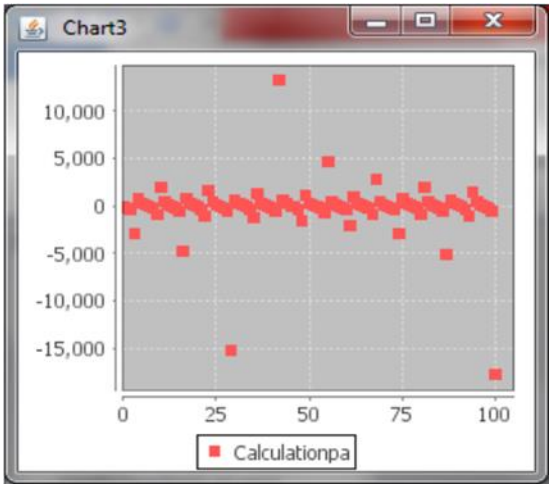

Fig. 7, Relationship of velocity and pa

False Handoff Initiation Probability -- Probability of false handoff initiation (pa) goes up as the cell size value of d goes up. It ends up wasting wireless resources needlessly. If false handoff initiation happens, that adds to the network loads, too.

4. Conclusion:

some algorithms exist for use in the heterogeneous network, and the best one is the adaptive algorithm. As mobile's speed and handoff are among the most important factors in network discovery, the algorithm is designed to efficiently manage overloaded traffic in the cells and set the most suitable or ideal time for handoff initiation. In addition, compare the probability that there will be a handoff failure. Issues such as failures of calls and data transfer being interrupted in the heterogeneous network would be taken care of by this algorithm.

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