Study and Survey on handoff failure in cellular Network and its minimization techniques

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Abstract— There is a growing demand on the mobile wireless operators to produce continuous, satisfactory and reliable quality of service. The continuation of an active cell is one of the most important quality measurements in cellular system. Handoff method permits a cellular system to produce continuation of an active cell once user moves from one cell to a different. Different approach are proposed and applied in order to archive better handoff service. To make a better handoff and keep quality of service in wireless network several handoff algorithms based on soft computing techniques are used in this paper.

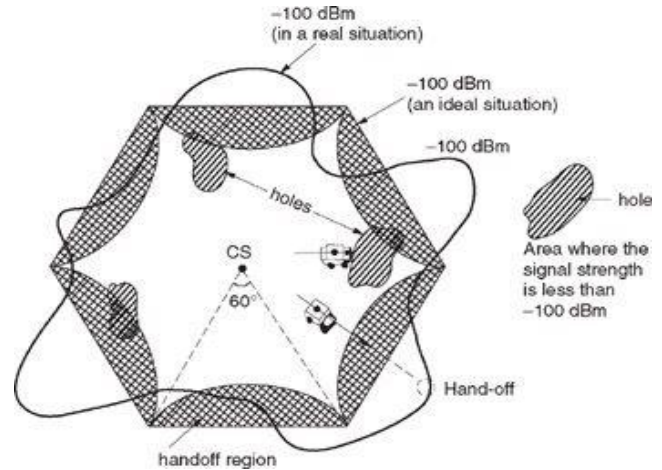*Index Terms*— Handoff, handoff initiation, soft computing, fuzzy logic, Mobile station.

Figure 1: Occurrence of handoff

I. INTRODUCTION

 Mobility is the most vital feature of a wireless cellular communication system. Commonly, continuous service is achieved by supporting handoff (or handover) from one cell to a different. Handoff (fig 1) is the method of changing the channel (frequency, time slot, spreading code, or combination of them) related to present connection while a call is in progress. It is typically initiated either by crossing a cell boundary or by deterioration in quality of the signal within the current channel. Handoff is split into two categories— hard handoff and soft handoff. They are in additionally characterized by "break before make" and "make before break" in hard handoff, current resources area unit released before new area unit resources are used; in soft handoff, every existing and new area unit resources are used throughout the handoff process.

 Badly designed handoff schemes tend to return with very heavy signaling traffic and, thereby, a dramatic decrease in quality of service (QoS). (In this chapter, a handoff is assumed to occur only at the cell boundary.) The explanation why handoffs are crucial in cellular communication systems is that neighbour cells are regularly using a disjoint subset of frequency bands; therefore negotiations should happen between the mobile station (MS), the present serving base station (BS), and therefore   the   next   potential   BS. Different connected problems, like deciding, and priority methods throughout   overloading,   may influence the general performance.

II. HANDOFF INITIATION

Handoff initiation is the method of deciding once to request a handoff. Handoff determination is based on the received signal strengths (RSS) from the current BS and neighbouring BSs. In Fig. 2, we examine the RSSs of the current BS (BS1) and one neighbouring BS (BS2). The RSS gets weaker as the MS moves away from BS1 and gets stronger as it gets closer to BS2 as a result of signal propagation characteristics. The received signal is mean over time employing an averaging window to get rid of momentary fading because of geographical and environmental factors [1-2]. Below, we will examine the four main handoff initiation techniques mentioned in [2-3]: Relative signal strength, relative signal strength with hysteresis, relative signal strength with threshold, and relative signal strength with threshold and hysteresis.
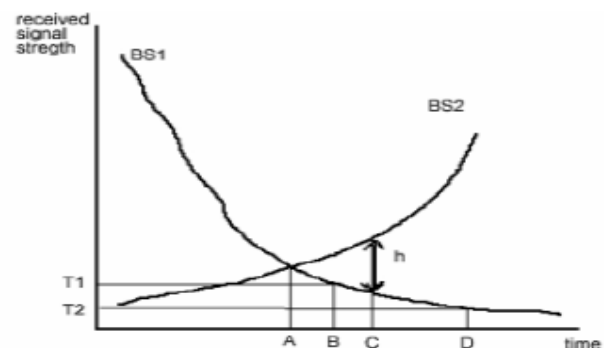

Figure 2: Movement of MS in the handoff zone

A. Comparative Signal Strength

In relative signal strength, the RSSs are measured over time and the BS with strongest signal is chosen to handoff. In Fig. 1, BS2's RSS goes over RSS of BS1 at point A, and handoff is

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requested. Because of signal fluctuations, many handoffs is also requested whereas BS1's RSS is still sufficient to perform the MS. These unwanted handoffs are known as the *ping-pong* effect. As the number of handoffs increase, force termination probability and network load additionally will increase. Therefore handoff techniques should avoid unnecessary handoffs.

B. Comparative Signal Strength with Threshold
Relative signal strength with threshold introduces a threshold value (T1 in Fig. 2) to beat the ping-pong impact. The handoff is initiated if BS1's RSS is below than the threshold value and BS2's RSS is stronger than BS1's. The handoff request is released at point B in Fig. 2.

C. Comparative Signal Strength with Hysteresis
This technique uses a hysteresis value (h in Fig. 2) to initiate handoff. Handoff is requested when the BS2's RSS exceeds the BS1's RSS by the hysteresis value h (point C in Fig. 2).

D. Comparative Signal Strength with Hysteresis and Threshold
The last technique combines both the threshold and hysteresis value concepts to come up with a technique with least quantity of handoffs. The handoff is requested when the BS1's RSS is less than the threshold (T1 in Fig. 2) and BS2's RSS is stronger than BS1's by the hysteresis value h (point C in Fig. 2). If we would choose a lower threshold than T1 (but higher than T2) than the handoff initiation would be somewhere at the right of point C. All the techniques mentioned above initiate handoff before point D, that is the "receiver threshold". The receiver threshold is that the minimum acceptable RSS for call continuation (T2 in Fig. 2) [1, 2]. If the RSS drops below the receiver threshold, the continuing call is than discontinued. The time interval between the handoff demand and receiver threshold modify cellular systems to delay the handoff request till the receiver threshold time is reached once the neighbour cell does not have any exhaust channels. This technique is known as queuing handoff calls and will be discussed in Section V. In [3], a handoff algorithm using multi-level thresholds is proposed which assigns different threshold values to the users according to their speed. Since low speed users spend longer time in handoff zone they are assigned a batter threshold to distribute high and low speed users evenly. High speed users are assigned least thresholds. The performance results obtained by [3] shows that an 8-level threshold algorithm operates better than a single threshold algorithm in terms of forced termination and call blocking probabilities. In [4] and [5], an improved threshold-based method is introduced and compared with the basic initiation techniques such as maximum power handoff (RSS or MPH), RSS with Hysteresis, RSS with threshold, and combinations of threshold and hysteresis based methods in a ten-cell structure.

III. TYPES OF HANDOFF

Hard & soft handoff: Originally hard handoff was used where a station must break connection with the old AP before joining the new AP thus resulting in large handoff postpone. However, in soft handoff the previous connection is maintained until a new one is established thus significantly reducing packet loss as shown in figure[3] In NGWS(next

generation wireless system) two types of handoff scenarios arise: horizontal handoff, vertical handoff[6][7].

A. Horizontal Handoff: When the handoff occurs between two BSs of the same system it is termed as horizontal handoff. It can be further classified into two:

B. Link layer handoff: Horizontal handoff between two BSs that are under the same foreign agent(FA).

C. Intra system handoff: Horizontal handoff between two BSs that belong to two different FAs and both FAs belong to the same gateway foreign agent (GFA) and hence to the same system.
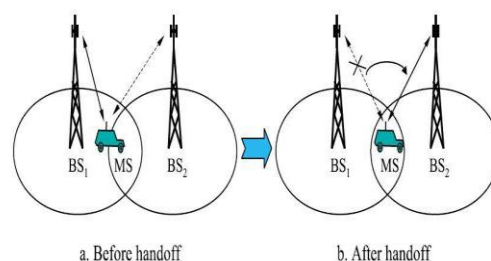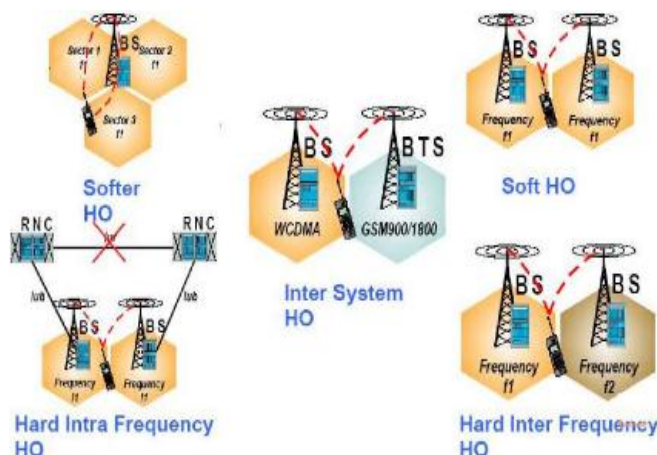

Figure 3:Hard handoff between the MS and BSs.

Figure 4: Hard handoff and soft handoff

IV. RELATED WORKS

A. Minimization of Handoff Failure Probability for Next-Generation Wireless Systems [16]
This method proposed to enhance the handoff performance of mobile IP in wireless IP networks by reducing the false handoff probability in the NGWS(Next-Generation Wireless Systems) handoff management protocol.

In this paper first discuss the different types of handoff in the next generation wireless systems. Then analyse the performance of handoff management protocols that use a fixed value of RSS threshold (Sth: The RSS threshold value to initiate the handoff). This suggests, when RSS of OBS goes below Sth, the Hierarchical Mobile IP (HMIP) registration procedures are initiated for MT's handover to the NBS.) to initiate the handoff process. Through our analysis, we observe that once a fixed value of Sth is used and handoff failure

probability increases when either speed or handoff signaling delay will increase. Based on this analysis, we propose a technique by that handoff failure probability can be kept constant and among limit.

Our analysis—In this method there are more chances to false handoff initiation because if hexagonal overlapping occurs, there will be a non-zero value of L. In that case, false handoff initiation probability will depend on cell size 'a', and hence its value will not be a constant. This value will be constant only for L=0, i.e., only when no overlapping occurs between two hexagonal cells.

B. Minimization of Handoff Failure by Introducing a New Cell Coverage Area in the Handoff Region [15]

This method proposed to minimize the handoff failure probability by effectively placing a wireless local area network (WLAN) AP in the handoff region between two neighbouring cells. The WLAN coverage provides an extra coverage within the low signal strength region and relieves the congestion within the cellular network. Moreover, we tend to perform the channel scanning (required for horizontal handover between the two base stations) among the WLAN coverage area, so minimizing the handoff failure due to scanning delay.

Thus by above proposed method, we can reduce handoff failure as well as handoff latency quite a remarkable amount as we can reduce the traffic in the cellular network by introducing a WLAN AP. The various advantages of incorporating the WLAN AP in the CN thus can be enlisted as follows.

1. This facility can relieve congestion on the GSM or UMTS spectrum by removing mutual types of calls and routing them to the operator via the relatively low value Internet.
2. This scheme allows carriers to add coverage using low cost 802.11 access points. Subscribers enjoy seamless coverage.
3. This handoff procedure cuts out the scanning delay from the handoff latency elements by scanning the channels whereas within the WLAN coverage.
4. The handoff failure probability tends to zero.

However, future works is done on rising the traffic distribution between the CN and WLAN, so that handoff failure is eliminated fully.

Our Analysis- In this method the result shows that to reduce handoff failure as well as handoff latency but result is not fully satisfactory there can be more improvement in traffic distribution in WLAN and CN so that handoff failure completely removed.

C. Application of Soft Computing Techniques for Handoff Management in Wireless Cellular Networks [17]

This application highlights the basic handoff mechanism and a brief description about some of the soft-computing techniques which can be applied for handoff management in modern cellular networks. At last I have proposed a Fuzzy Logic based handoff technique using Fuzzy tool of MATLAB 7.6.0.

1. Fuzzy Logic

Fuzzy logic (FL) was developed by Zadeh in 1964 to address uncertainty and imprecision, which widely exist in the engineering problems [10]. Fuzzy set theory are often though-about as a generalization of the classical set theory. In classical set theory, a element of the universe either belongs or not belong to the set. Thus the degree of union of an element is crisp. In a fuzzy set theory the union of an element may be endless varying. Mathematically, a fuzzy set could be a mapping (known as membership function) from the universe of discourse to the closed interval. Membership function is the measure of degree of similarity of any element in the universe of discourse to a fuzzy subset. Piecewise-linear, triangular, trapezoidal and Gaussian functions are most commonly used membership functions. The membership function is usually designed by taking into consideration the requirement and constraints of the problem. Fuzzy logic implements human experiences and preferences via membership functions and fuzzy rules. Due to the utilization of fuzzy variables, the system is created understandable to a non-expert operator. During this method, fuzzy logic can be used as a general methodology to include information, heuristics or theory into controllers and decision makers.

a. Proposed fuzzy logic based techniques

Figure. 5 shows the structure of the proposed fuzzy inference system. In the direction of design a model of fuzzy logic system the following steps are used:

- Identify the inputs and outputs using linguistic variables. In this stage we have to describe the number of inputs and output terms lingually.
- Assign membership functions to the variables. During this stage we will assign membership functions to the input and output variables.

• Build a rule base, In this step we will build a rule base between input and output variables. The rule base in the course of a fuzzy system takes the shape of IF--AND---OR, THEN with the operations AND, OR, etc.
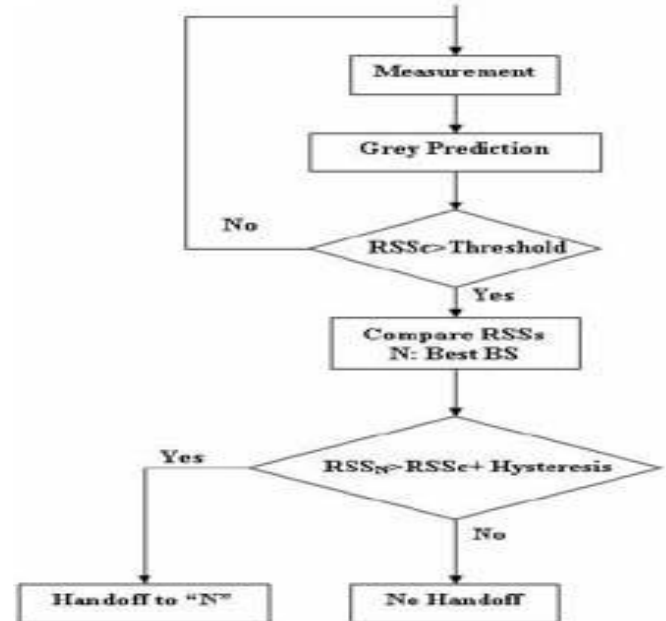

Figure: 5

Our Analysis- In this method fuzzy logic based soft computing technique to find out the handoff decision of the mobile terminals in wireless cellular networks and the result shows that the handoff decisions are taken in appropriate positions so that the load at base stations and Mobile switching centre (MSC) is reduced. we analyse that there are many soft computing techniques are available like neural network, can be used in place of fuzzy logic .In future we will implement it on FPGA and also design a handoff mechanism based on another soft computing technique.

D. Optimization of vertical handoff performance parameters in heterogeneous wireless network[18]
In this we have used the multiple optimization problem(MOP) concept to represent multiple number of vertical handoff criteria which will select the best available network with optimized parameter values (such as latency of network should be minimum) in the heterogeneous wireless network. The formulated multiple objective functions is implemented using genetic algorithm. Then the problem is simulated using Matlab.
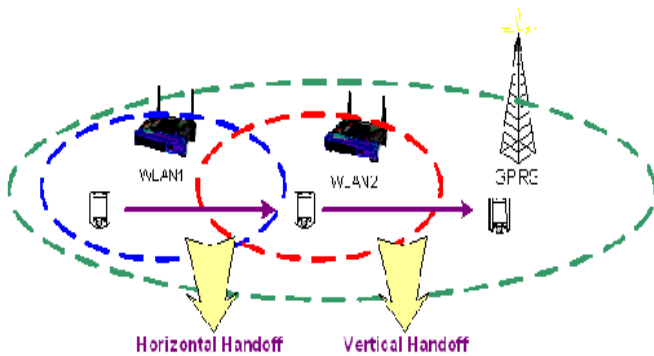

figure:6

A.Vertical Handoff : When the handoff occurs between two BSs that belong to two different GFAs and hence to two different systems it is termed as vertical handoff as shown in figure 6. A vertical handover (VHO) is the mechanism by which an ongoing connection is transferred from one BS to an AP and vice versa [8]. VHO can be classified in two categories namely upward-downward handover techniques and imperative-alternative handover techniques. An upward VHO occurs from a network with small coverage and high data rate to a network with wider coverage and lower date rate. On the other hand, a downward VHO occurs in the opposite direction. As an example for this classification let's consider the case of two of the most important current wireless technologies: 3G cellular networks and WLANs. The WLAN system can be considered as the small coverage network with high data rate while the 3G cellular system is the one with wider coverage and lower data rate. An imperative VHO occurs due to low signal from the BS or AP. In other words, it can be considered as an HHO. The execution of an imperative VHO has to be fast in order to keep on-going connections. On the other hand, a VHO initiated to provide the4 user with better data-rate is called the alternative VHO.
The VHD scheme consists of three VHD modules: Handoff Need (HN), Target Network Selection (TNS), and Handover Performance Parameter Estimation (HPPE). The handoff need module is used to predict the necessity of handoff. The necessity of handoff is predicted by using the handoff prediction algorithm which is based on received signal strength (RSS) concept. If the RSS of the MN in current network is less than the RSS of other existing networks then there will be a need for handoff. Then after knowing that there is a need for handoff then the next step is to decide the target network for handoff. In our research work this step is handled by the handoff target selection module using multiple objective optimization concepts that defines the main objective. Here the parameters of the networks can be represented by different criteria. The target network will be the network with minimum latency value, signal-to-noise ratio, power consumption and maximum throughput. Then HPPE module is used to optimize the throughput, packet loss, no of handoff and handoff failure probability of MN, across different APs or BSs during handoff which shows the performance of the proposed algorithm.
The proposed handoff approach can handle the following optimization problems of vertical handoff in heterogeneous wireless network. (a) Handoff is done fast and its delay is as less as possible (b) Number of handoff is minimized, which avoids degradation in signal quality and additional loads of the network(c) Throughput during handoff is maximized (d) Handoff latency during handoff is minimized (e) Handoff procedure is reliable and successful (f) Handoff algorithm is simple and has less computational complexity etc.

V. CONCLUSION

In wireless networks, handoff between cells is inevitable because it's most important to keep up the continuing calls. There are occurrences wherever a handoff is unsuccessful and lots of analysis was conducted concerning this. The main reason was found out in late 80's. In adjacent cells, when a user moves from one cell to a different frequencies cannot be reused; a brand new frequency should be allotted for the call. The user's call must be terminated if a user moves into a cell once all accessible channels are in use. Also, there is the problem of signal interference wherever adjacent cells overpower one another leading to receiver decrement. In this paper, an improved handoff scheme for minimizing handoff failure in mobile networks was developed and analysed. Overcome to false handoff initiation, new cell coverage area in the handoff region, soft computing techniques for handoff management etc. After studding all the higher than papers [15, 16, 17, 18] our conclusion is that handoff failure is that the most difficult space in cellular network.

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