Review of Handoff Strategies in Wireless Mobile Networks Schemes

Tamanna Kundra[1]Abhinav Sharma[2]
[1,2]Student (B.Tech 7[th]sem)
[1,2]Department of Electronics and Computers Engineering
[1,2]Dronacharya College of Engineering, Gurgaon-123506, India

Abstract**—***The Mobility in wireless cellular communication systems is its backbone so as to enhance the quality of service and maintain the continuous service. Handoff is an important task in maintaining the continuity of call in cellular systems and its failure can result in ongoing call termination. So handoffs are necessary for providing an enhanced QoS (Quality of Service) to users and provide a ubiquitous coverage. In order to successfully implement the handoff process, the system designers make a proper optimum signal level at which point handoff will initiate. During the handoff process some parameters like relative signal strength, relative signal strength with threshold, relative signal strength with hysteresis and relative signal strength with hysteresis and threshold are to be considered carefully. So this paper shows the brief description about the different handoff techniques in cellular systems moreover it compares all the handoff strategies on the basis of execution time, S/I ratio, RSS (Relative Signal Strength), call handling difficulty, handoff made and generation methods. Handoff strategies are very used in wireless communication where it can be known that which handoff strategy is not using in very efficient manner and it can also find the brief comparison between all handoff strategies which are used in mobile communication.*

Keywords—QoS (Quality of Service), Handoffs, Mobility

I. Introduction

The Mobility in wireless cellular communication systems is its backbone so as to enhance the quality of service and maintain the continuous service. Handoff is an important task in maintaining the continuity of call in cellular systems and its failure can result in ongoing call termination. So handoffs are necessary for providing an enhanced QoS (Quality of Service) to users and provide a ubiquitous coverage. In order to successfully implement the handoff process, the system designers make a proper optimum signal level at which point handoff will initiate. During the handoff process some parameters like relative signal strength, relative signal strength with threshold, relative signal strength with hysteresis and relative signal strength with hysteresis and threshold are to be considered carefully. So this paper shows the brief description about the different handoff techniques in cellular systems moreover it compares all the handoff strategies on the basis of execution time, S/I ratio, RSS (Relative Signal Strength), call handling difficulty, handoff made and generation methods. Handoff strategies are very used in wireless communication where it can be known that which handoff strategy is not using in very efficient manner and it can also find the brief comparison between all handoff strategies which are used in mobile communication.

The Mobility in wireless cellular communication systems is its backbone so as to enhance the quality of service and maintain the continuous service. Handoff is an important task in maintaining the continuity of call in cellular systems and its failure can result in ongoing call termination. So handoffs are necessary for providing an enhanced QoS (Quality of Service) to users and provide a ubiquitous coverage. In order to successfully implement the handoff process, the system designers make a proper optimum signal level at which point handoff will initiate. During the handoff process some parameters like relative signal strength, relative signal strength with threshold, relative signal strength with hysteresis and relative signal strength with hysteresis and threshold are to be considered carefully. So this paper shows the brief description about the different handoff techniques in cellular systems moreover it compares all the handoff strategies on the basis of execution time, S/I ratio, RSS (Relative Signal Strength), call handling difficulty, handoff made and generation methods. Handoff strategies are very used in wireless communication where it can be known that which handoff strategy is not using in very efficient manner and it can also find the brief comparison between all handoff strategies which are used in mobile communication.

II. Types of Handoffs

Handoffs are broadly classified into two categories—hard and soft handoffs. Usually, the hard handoff can be further divided into two different types—intra- and intercell handoffs. The soft handoff can also be divided into two different types—multiway soft handoffs and softer handoffs. In this paper, we focus primarily on the hard handoff

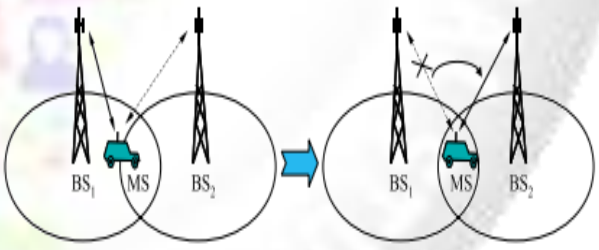

Fig.1 Hard Hand off Between MS and BS

A hard handoff is essentially a ―break before make connection. Under the control of the MSC, the BS hands off the MS‘s call to another cell and then drops the call. In a hard handoff, the link to the prior BS is terminated before or as the user is transferred to the new cell‘s BS; the MS is linked to no more than one BS at any given time. Hard handoff is primarily used in OFDMA (orthogonal frequency division multiple access) and TDMA (time division multiple access), where different frequency ranges are used in adjacent channels in order to minimize channel interference. So when the MS moves from one BS to another BS, it becomes impossible for it to communicate with both BSs (since different frequencies are used). Figure (1) illustrates hard handoff between the MS and the BSs.

III. THE DESIGN OF THE HANDOFF PROTOCOL

Wireless communication is exhibiting its fastest growth period in history; due to enabling technologies which permit a wide spread deployment. Now a day's cellular systems are the most popular system used in the telecommunication industries. The data services or voice speeches are conveyed very easily by the mobile terminal. A cellular system provides a wireless connection to the PSTN for any user location within the radio range of the system. Cellular systems have a large number of users over a large geographical area, within a limited frequency spectrum. Cellular radio systems provide a high quality service,which is comparable with the landline telephone system.

The data services or voice speeches are conveyed very easily by the mobile terminal. A cellular system provides a wireless connection to the PSTN for any user location within the radio range of the system. Cellular systems have a large number of users over a large geographical area, within a limited frequency spectrum. Cellular radio systems provide a high quality service, which is comparable with the landline telephone system. So in cellular mobile networks, the large geographical coverage area or region is divided
into small services area. They are called cells within its region. Before communication between two users
in a network, the frequency band is divided into smaller bands. These bands are reused in non-interfering cells and the group of frequency bands or channel should be assigned.

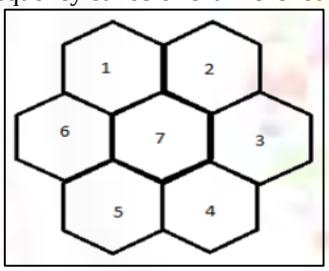

Fig.2 Cellular Structure of a Cell

When a mobile user or mobile terminal crosses the cell boundary or passes out of the range, the signal gets unacceptable. The transition and the process to make the transition are called handoff. The term handoff does not mean a physical change in the assigned channel but rather that the different base station handles the radio communication task. Thus handoff is the process where the call transfers a mobile station from one base station to another base station or one cell boundary to another cell boundary i.e. shown in figure above. A hard handoff occurs when the old connection is broken before a new connection is activated. The performance evaluation of a hard handoff is based on various initiation criteria [2]. It is assumed that the signal is averaged over time, so that rapid fluctuations due to the multipath nature of the radio environment can be eliminated. Numerous studies have been done to determine the shape as well as the length of the averaging window and the older measurements may be unreliable. Figure (2) shows a MS moving from one BS (BS1) to another (BS2). The mean signal strength of BS1 decreases as the MS moves away from it. Similarly, the mean signal strength of BS2 increases as the MS approaches it.

IV. HANDOFF INITIATION

Handoff initiation is the process of deciding when to request a handoff. Handoff decision is based on the received signal strengths (RSS) from the current BS and neighboring BSs. In Fig. 1, we examine the RSSs of the current BS (BS1) and one neighboring 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 averaged over time using an averaging window to remove momentary fadings due to geographical and environmental factors [1-2]. Below, we will examine the our main handoff initiation techniques mentioned in [2-3]: Relative signal strength, relative signal strength with threshold, relative signal strengthwith hysteresis, and relative signal strength with hysteresis and threshold.

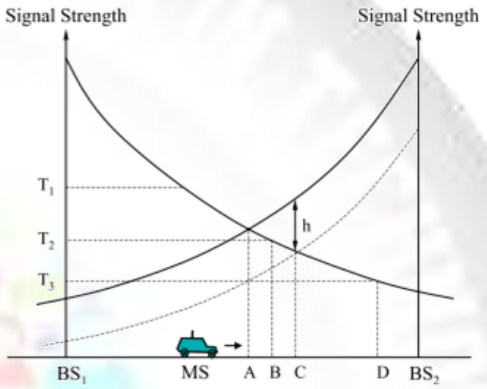

Fig. 2: Signal strength and hysteresis between two adjacent BSs for potential handoff.

A. Relative 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 exceeds RSS of BS1 at point A and handoff is requested. Due to signal fluctuations, several handoffs may be requested while BS1's RSS is still sufficient to serve the MS. These unnecessary handoffs are known as the Ping-Pongeffect. As the number of handoffs increase, forced termination probability and network load also increases. Therefore, handoff techniques should avoid unnecessary handoffs.

B. Relative Signal Strength with Threshold

Relative signal strength with threshold introduces a threshold value (T1 in Fig. 1) to overcome the ping-pongeffect. The handoff is initiated if BS1's RSS is lower than the threshold value and BS2's RSS is stronger than BS1's. The handoff request is issued at point B in Fig. 1.

C. Relative Signal Strength with Hysteresis

This technique uses a hysteresis value (h in Fig. 1) 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. 1).

D. Relative Signal Strength with Hysteresis and Threshold

The last technique combines both the threshold and hysteresis value concepts to come up with a technique with minimum number of handoffs. The handoff is requested when the BS1's RSS is below the threshold (T1 in Fig. 1) and BS2's RSS is stronger than BS1's by the hysteresis value h (point C in Fig. 1). 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 discussed above initiate handoff before point D, which is the "receiver threshold". The receiver threshold is the minimum acceptable RSS for call continuation (T2 in Fig. 1) [1, 5]. If the RSS drops below the receiver threshold, the ongoing call is than dropped. The time interval between the handoff request and receiver threshold enable cellular systems to delay the handoff request until the receiver threshold time is reached when the neighboring cell does not have any empty channels. This technique is known as queuing handoff calls and will be discussed in Section V. In [8], 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 more time in handoff zone they are assigned a higher threshold to distribute high and low speed users evenly. High speed users are assigned lower thresholds. The performance results obtained by [8] shows that an 8-level threshold algorithm operates better than a single threshold algorithm in terms of forced termination and call blocking probabilities. In [9] and [10], an improved threshold-based method is introduced and compared with the basic initiation techniques such as maximum power handoff (MPH or RSS), RSS with hysteresis, RSS with threshold, and combinations of hysteresis and threshold based methods in a ten-cell structure.

V. CONCLUSION:

In this paper, we introduced an overview on the concept of handoff and its evaluation parameters. We discussed the handoff initiation techniques based on the received signal strength and also the handoff decision protocols that are used. In addition, the handoff types based on channel usage, microcellular and multilayered systems and network characteristics are explained. Finally, we presented the handoff prioritization schemes to reduce the handoff call blocking probability, such as guard channels and queuinghandoff calls.

REFERENCES:

[1] AT&T. WaveLAN: PC/AT Card Installation and Operation.
[2] H. Balakrishnan, S. Seshan, and R.H. Katz. Improving Reliable Transport and Handoff Performancein Cellular Wireless Networks. ACM Wireless Networks, 1995. To appear.
[3] R. Caceres and L. Iftode. Improving the Performance of Reliable Transport Protocols in MobileComputing Environments. IEEE JSAC, 13(5), June 1994.
[4] The Daedalus Project Home Page. http://daedalus.CS.Berkeley.EDU/, 1995.
[5] Steve Deering. Host Extensions for IP Multicasting. RFC, SRI International, Menlo Park, CA,August 1989. RFC-1112.
[6] WaveLAN: PC/AT Card Installation and Operation.
[7] H. Balakrishnan, S. Seshan, and R.H. Katz. Improving Reliable Transport and Handoff Performancein Cellular Wireless Networks. ACM Wireless Networks, 1995. To appear.
[8] R. Caceres and L. Iftode. Improving the Performance of Reliable Transport Protocols in Mobile Computing Environments. IEEE JSAC, 13(5), June 1994.
[9] The Daedalus Project Home Page. http://daedalus.CS.Berkeley.EDU/, 1995.
[10] Steve Deering. Host Extensions for IP Multicasting. RFC, SRI International, Menlo Park, CA,August 1989. RFC-1112.
[11] A. Iera, A. Molinaro and S. Marano, "Handoff Management with Mobility Estimation in Hierarchical Systems", IEEE Transactions on Vehicular Technology, vol. 51, Sept. 2002, pp. 915-934.
[12] Y. Kim, K. Lee and Y. Chin, "Analysis of Multi-level Threshold Handoff Algorithm", Global Telecommunications Conference (GLOBECOM'96), vol. 2, 1996, pp. 1141-1145.
[13] S. ShirvaniMoghaddam, V. TabatabaVakili and A. Falahati, "New Handoff Initiation Algorithm (Optimum Combination of Hysteresis & Threshold Based Methods)", Vehicular Technology Conference (VTC 2000), vol. 4, 2000, pp. 1567-1574.
[14] V. TabatabaVakili and S. ShirvaniMoghadddam, "Optimum Selection of Handoff Initiation Algorithm and Related Parameters", Communication Technology Proceedings (WCC - ICCT 2000), vol. 1, 2000, pp. 563-567.