

Location Prediction to Reduce Hand-Off Delay for Seamless Mobility of VOIP

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ABSTRACT: As the number of mobiles and mobile networks increases, there are lot many problems and challenges arising with different standards and technologies. Among these the problem of handoff is a big parameter which affects the performance drastically. Many ideas and schemes for handoff mobiles with low latency have been proposed in the past. As new technologies and more number of networks increases every day, the existing ideas are no longer supported efficiently. So we need a different handoff schemes that consider the current situation and one such handoff scheme is location prediction which predicts the future movements and so handoff can be predicted in advance and therefore handoff latency can be reduced but prediction of handover in advance is very difficult. The hints like user movement patterns, base station topological position, signal quality etc will be helpful in prediction of handoff in advance. This paper reduces the handoff delay in mobile networks using location prediction where the frequent number of switching between the base stations with respect to the user movements will be minimized.

I. INTRODUCTION

The second generation and third generation mobile systems depend on the employment of the radio spectrum. The difference in bandwidth and coverage area encourages the multi-network interface devices. The multi-network interface device has the ability to access services of various networks. The 4G technology devices has such facility, it has higher bandwidth, large data rate and smoother and quick handoff. The 4G services and networks may not be available in all the area, where the user can travel. In this situation the handoff must happen between different network systems with different standards.

Mobiles will get the services from the base station. When the mobile moves away from one base station and enter in to another base station's coverage area then handoff will occur. Handoff is a process of reconfiguring the mobile host, the wireless network and backbone wired network to support communication after a user enters a different cell of the wireless network. Normally few milliseconds of interrupt will happen during handoff process. This delay should be reduced for smooth performance. We can classify handoff in to two categories, one is soft handoff and the other one is hard handoff. The handoff is said to be soft if the mobile need not get disconnected from the old access point before connecting new access point. The handoff is said to be hard when mobile needs to get disconnected from the old access point before connecting new access point. The network that uses CDMA can able to perform soft handoff, because the mobile node of CDMA network has the ability to receive signals from multiple base stations at a time. Where, in network like GSM, the mobile nodes have the ability to receive signals only from single access point at a time. If it needs to access signals from new access point then it has to disconnect the old connection from old access point.

When the user travels from one cell to another cell the call should be transferred to the new cell's base station. Else the call will be disconnected because the link with the current base station becomes weak. Handoff is a process of reconfiguring the mobile host, the wireless network and backbone wired network to support communication after a user enters a another cell of the network.

Although large number of research on vertical handoff has been published recently, no solution meets the requirement for 100 percent mobility. The purpose of this review paper is to reduce the handoff delay to achieve continuous connection, related to vertical handoff

II. WIRELESS NETWORK ARCHITECTURE

As shown in figure 1 the radio coverage region is partitioned into geographical areas, called location areas. Every location area consists of a group of cells. Each cell is served by a base station that assigns radio frequencies, to each mobile node within the cell. The base stations regularly broadcast the identifiers of their cells and thus the mobile nodes will know in which cell they are now by listening to the broadcast channel. All neighboring cells in a location area are managed by a base station controller which is used to control all the base stations in the location area for performing their jobs and a mobile switching service center maintains a visitor location register. This records information about the mobile nodes in the cells are served by the mobile switching center. The wireless network architecture also has a database, called home location register (HLR), which records the movements of each mobile user from its current cell to another cell. Therefore, it is possible to get the movement history of user from the HLR's log data which is needed in our work to predict the future location.

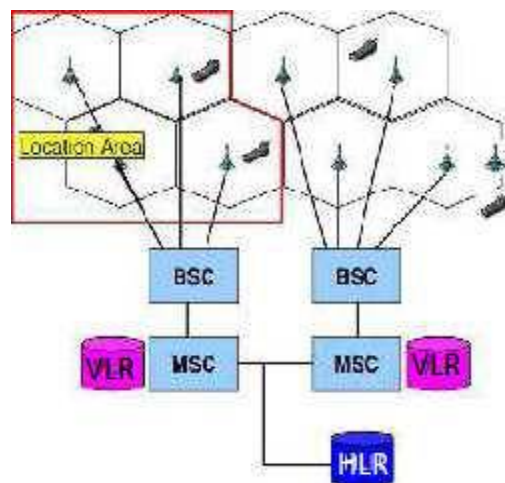


Figure 1. Wireless Network architecture

III. VERTICAL MOBILE HANDOFF

Nowadays the mobiles are very much important, so we need a system for accessing networks based on various perspectives. Also the number of mobile users, mobile network and mobile applications increases every year, the network operators are struggling in improving seamless handover of devices and services. The operators have to integrate multiple technologies so that unlimited message can be delivered to the user. The deployment of access points to cover smaller areas at low cost may increase the number of networks available.

Vertical handover is the processes that switch a mobile node from one technology to another in order to maintain a communication in a network. Heterogeneous Networks are two networks whose entities support different technologies. Because of the benefits brought about by 3G networks such UMTS, it is increasingly desirable to integrate 3G networks with WLAN.

In a wireless network, an algorithm that departs from the conventional RF based algorithm is necessary to achieve a beneficial vertical handover. An attempt is made in this type of study to provide such algorithm which aims to utilize location information stored in WLAN coverage database, and the location service entities of UTRAN as defined by 3GPP to determine a valuable and beneficial vertical handover between UMTS and WLAN.

IV. HANDOFF WITHOUT LOCATION PREDICTION

The need of hand-off is specified by the measurement of signal strength or carrier to interference ratio (CIR) value which is considered as an important value in a cell. Low value of CIR will indicate to change the use of the present channel. The hand-off decision is difficult as mobile radio channel is a fading channel.

Handover without prediction of location in advance increases the number of switching between the base stations hence increasing the hand-off latency.

In handoff without location prediction, the presence of say four base stations in a particular region or domain each with a fixed value of signal strength or power is considered. A mobile user's path is given as input in the MATLAB. The results had displayed the base stations with the maximum received signal strength at each corresponding user location. Also the no of switching between base stations are calculated.

V. PREDICTION ALGORITHMS

Location prediction:

With the increasing number of mobile devices, performance becomes more and more essential for location prediction. There are two classes of application that can benefit from accurate prediction of a user's location: end-user applications, where the object is to predict locations so that a human user can prepare or react accordingly, and system – enhancement applications, where the location prediction can be used to enhance system performance, availability or other metrics. The task of the location prediction algorithm is to provide the user's (symbolic) location at the next time step, or, if possible, the path of the user (a sequence of locations) over several time steps. The user's predicted location at the next time step may be the same as the current location. Location prediction may be explicitly or implicitly used in many areas of mobile and wireless system design. Location Prediction Algorithm is applied over the entire population of the user

$$pS > A + (1-p)F \text{ -----(1)}$$

Where,

p = probability of successful prediction

S = benefit of success

A = cost of running the algorithm

F = cost of failure

Handoff occurs when the signal strength of the serving base station is at a level below threshold and the signal strength of the neighbouring base station is higher than the signal strength of the serving base station. An unintentional handoff to the wrong cell may sometimes occurs. To reduce such wrong handoff, handoff is delayed until the received signal strength received by the MS from a neighbouring station is of enough value, to achieve the threshold of the intended new base station with the RSS-H algorithm, and this enhances system performance.

If received signal from BTS1 is less than received signal from BTS2 by a margin, h then handover will be there from BTS1 to BTS2. Similarly, if received signal from BTS2 is less than received signal from BTS1 by a margin, h then handover will be there from BTS2 to BTS1. This is simply made clear by using following equations

$$[Prx2,avg(k) - Prx1,avg(k)] > + h$$

HO: BTS1 to BTS2 -----(2)

$$[Prx2,avg(k) - Prx1,avg(k)] < - h$$

HO: BTS2 to BTS1 -----(3)

Particular area of cellular network and available base stations in that cellular network have been determined. Received Signal Strength Indication (RSSI) for the considered base stations have been calculated. Finally either Handoff success (mobile node needs to be switched from old access point to new access point) or hand-off failure (mobile node must remain connected to the same base station) among available base stations for the user movement based on the obtained RSSI is found out by using domain specific algorithm.

Domain specific algorithms:

Domain specific algorithm considers the geometry of the user motion and the semantics of symbols in the user's movement history. This algorithm depends on Network conditions, number of networks, estimate time, mean rate of the call etc., are also considered. This is based on the RSSI measurements and is independent of the long-term movement of the user.

a. Mobile motion prediction (MMP)

One of the domain specific algorithm that can be used for improving mobility management in a cellular network is mobile motion prediction (MMP). The movement of a user is modeled as a process $\{M(a,t):a \in A, t \in T\}$ where A is the set of possible locations (called states) and T is an index set indication time. It is assumed that the user's movement is composed of a regular movement process $\{S(a,t)\}$ and a random movement process $\{X(a,t)\}$. A location is called a stationary state if the user resides there longer than some threshold time interval, and a transitional state otherwise. A location at the geographical boundary of service area is called a boundary state for convenience we call the stationary and boundary states marker states. Two types of movement patterns are then defined. A Movement Circle is a sequence of locations that begins and ends with the same location and contains at least one marker state. A movement track is sequence of locations that begins and ends with a marker state.

Similar to the handoff without location prediction, in handoff with location prediction also, the results of MATLAB had shown the base station with the maximum received signal strength at the corresponding user location. Also the no of switching between base stations are calculated.

VI. RESULTS

Comparison of handoff:

Without prediction vs with prediction

Region with four base stations are considered and it is assumed that user is traveling through some path over the region. For clear understanding and better comparison five paths are considered. Table 1 shows to which base station the user is connected as he moves.

- Path I – [[-1,2][1,2][2,-1][0,-2][-2,-3][1,-1][-3,2]]
- Path II – [[-1,0][2,-3][0,0][4,0][1,5][-4,-2][-2,-5]]
- Path III – [[3,1][1,-2][4,-1][-3,-3][-1,-2][-4,0][0,5]]
- Path IV – [[-3,-4][1,-1][4,3][0,2][3,4][0,0][-3,-2]]
- Path V – [[5,5][5,-5][-5,-5][-5,5][1,0][-5,1][-3,-1]]

No of path	connected base station without location prediction							connected base station with location prediction						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Path I	BS1	BS1	BS2	BS2	BS3	BS2	BS4	BS1	BS2	BS2	BS3	BS3	BS3	BS4
II	BS1	BS3	BS1	BS2	BS1	BS4	BS4	BS1	BS3	BS3	BS2	BS2	BS4	BS4
III	BS2	BS3	BS2	BS4	BS3	BS4	BS1	BS2	BS3	BS3	BS4	BS4	BS4	BS1
IV	BS4	BS4	BS2	BS1	BS2	BS1	BS4	BS4	BS2	BS2	BS2	BS2	BS2	BS4
V	BS2	BS3	BS4	BS1	BS2	BS1	BS3	BS2	BS3	BS4	BS1	BS1	BS1	BS1

Table 1. Base station connected to its corresponding location

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S.no	No of switching (without location prediction)	No of switching (with location prediction-DomainSpecific Algorithm)
Path I	4	3
II	5	3
III	6	3
IV	5	2
V	6	3

Table2. No of switching

S.no	Hand-off latency (without location prediction)	Hand-off latency (with location prediction-DomainSpecific Algorithm)
1	0.1006ms	0.0925ms

Table3. Hand-off latency

VII.CONCLUSION

I had adopted a prediction algorithm that aims at reducing the handoff latency by minimizing the frequent number of switching between the base stations with respect to the user movement. Thus I had focused on mitigating a handover-related issue by using location-based information. This is only one aspect of the benefits that could results from utilizing location based information in the wireless domain.

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