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Location Prediction to Reduce Hand-Off Latency in Mobile Network for Seamless Mobility Using NS2

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Abstract: With the increase in number of mobiles and mobile networks, there are lot many problems and challenges arising. Among these handoff is a big parameter which affects the network performance drastically. Though lot many ideas and schemes for handoff mobiles with low latency have been proposed, none of them are supported effectively. 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 by deducing the past movements. By doing this handoff can be predicted in advance and therefore handoff delay can be reduced but prediction of handover in advance is very difficult. The hints like signal quality, user movement patterns, base station topological position etc will be helpful in location prediction. In this paper reduction of handoff latency in mobile networks using location prediction will be shown in ns2.

I. INTRODUCTION

The second 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 different networks. The 4G technology devices has such facility, it also has higher bandwidth, large data rate 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. 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.

Predicting the location of a user or a user's mobile device is an inherently interesting problem and one that presents many open research challenges 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 figure1 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.

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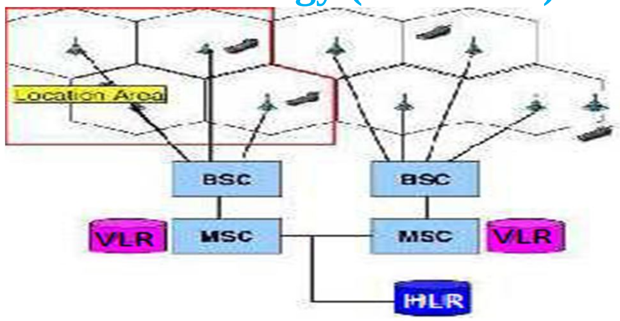

Figure 1.Wireless Network architecture

III. VERTICAL MOBILE HANDOFF

Now a days 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. DURATION OF HANDOVER INTERRUPTION

A handover interruption in mobile wireless systems is caused by switching of a MS from a serving BS to a target BS. Explanation of the interruption caused by the hard handover is presented in below figure. Before handover, the MS communicates with the serving BS. All connections with the serving BS are terminated if the MS crosses a border of cells between the serving and target BSs and the MS has no connection to the network. Subsequently, new connections with the target BS are established . The short interruption in connection begins when the MS gets disconnected from the serving BS and it lasts until the MS sets up new connections with the target BS. During interruption, all packets must be forwarded from the serving BS to the target BS via backbone. When the connections between the MS and target BS are established, the packets are transmitted to the MS.

The handover procedure can be separated into several stages: network topology advertisement, scanning of MS's neighborhood, cell reselection, handover decision and initiation, synchronization and network re-entry .First two stages, network topology advertisement and scanning of MS’s neighborhood, are performed before the start of handover process. These stages enable the MS to investigate and collect information on all neighboring BSs. Within scanning process, the MS seeks for a suitable target BS or BSs that are appropriate to be added to a diversity set. The scanning is accomplished in so called scanning intervals which interleave normal operation of the MS. Once the scanning is finished, the MS sends results back to the serving BS. The scanning results can be delivered to the serving BS.

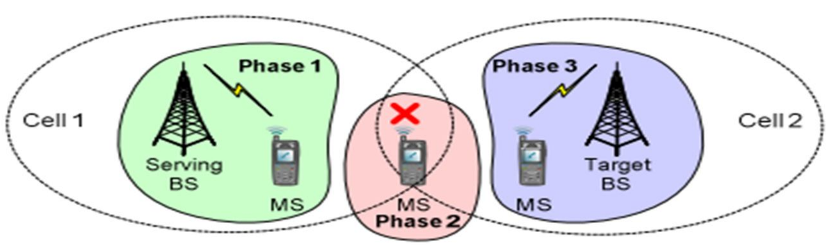

Figure2: Duration of handover interruption

The results obtained during the scanning process are used in the next step of the handover procedure, i.e. cell reselection. In this step, a possible target BS is selected based on channel parameters and/or offered QoS. Afterward, handover decision and initiation phase is performed if all conditions and requirements for the handover are fulfilled. The first step after the handover initiation is MS's synchronization to the downlink channel of target BS. Before the synchronization is completed, all connections with the serving BS are closed and the MS cannot neither receive nor transmit data. This time corresponds to the beginning of handover interruption. As soon as the synchronization with the downlink channel of target BS is finished, the MS can start next stage of handover – network re-entry procedure. The network reentry consists of three substages: ranging, re-authorization and re-registration. At the beginning of the ranging process, the MS obtains information on an uplink channel through UCD (Uplink Channel Descriptor) message and information on resource allocation by means of UL-MAP (Uplink MAP) message. Consequently, ranging parameters (such as transmitting power, timing information or frequency offset) are exchanged. The ranging process is followed by the re-authorization and re-registration of the MS to the target BS. After the successful authorization and registration, the MS can start with normal operation.

The principle of both types of soft handovers (MDHO and FBSS) is based on a simultaneous communication with more than one BS. Therefore the duration of handover interruption is different in comparison to the hard handover. In case of the MDHO, a MS and BSs have to maintain a diversity set. The MS communicates (including user traffic) simultaneously with all BSs in a diversity set. Therefore, if the diversity set contains more than one BS, no delay of data packets is introduced by the MDHO. The delay is similar as in case of the hard handover if just one BS is included in the diversity set since the same MAC management messages as during the hard handover are exchanged. Only the content of these messages is slightly modified.

V. 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 location prediction in advance increases the number of switching between the base stations hence increasing the hand-off latency.

VI. PREDICTION ALGORITHMS

A. 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

$pS > A + (1-p) F$ ------(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 neighboring 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 neighboring 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: BTS1to 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 has 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.

B. 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.

1) *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 mode as a process {M(a,t):a€ A, t €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. Mobility Prediction rule is to express the beacon update process. The goal of this rule is to send the next beacon update from the node when the error occurred between the predicted locations. A simple location Prediction scheme is used. The position information is broadcast only if the previous beacon becomes inaccurate. If the predicted error in the position estimate is greater than a certain threshold then the next beacon is broadcast immediately. The beacon generation is adapts to the frequency by this rule. It determines the characteristics that change the nodes. These characteristics are governed to their motion.

VII. NETWORK SIMULATOR

NS2 is an open-source simulation tool that runs on Linux. It is a discreet event simulator targeted at networking research and provides substantial support for simulation of routing, multicast protocols and IP protocols, such as UDP, TCP over wired and wireless (local and satellite) networks. It has many advantages that make it a useful tool, such as support for multiple protocols and the capability of graphically detailing network traffic. Additionally, NS2 supports several algorithms in routing and queuing. NS2 is available on several platforms such as FreeBSD, Linux, SunOS and Solaris.

The proposed method addresses the handoff delay packet loss and throughput . In order to evaluate the performance of the location prediction algorithm (Domain specific) and to compare it with conventional algorithm (without location prediction), the below parameters are configured in the network simulator.

Node Methods: Configuring the Node

Channel type: Wireless channel

Propagation model: Two ray ground model

Mac Type: IEEE 802.11

Interface Queue Type : Droptail/Priqueue

Antenna Type: Omni antenna

X dimension of topography: 250

Y dimension of topography: 250

Max Packet in Interface queue: 50

Simulation time: 200ms

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A. Simulation Procedure

Initially event scheduler object is created and topography object is set up. Nodes will be configured and set followed by node coloring and labeling. Initial location of mobile nodes is provided along with distance calculation. Next random mobility and trustworthy for all the nodes are made clear and the region separation is said to be carried out. Once the region is divided, alpha is calculated. It mainly depends upon low mobility and trustworthy of the nodes. Later TCP connection is set up . The active senders start informing the network about its presence and begin sending data according to the random progress method. Finally Nodes will be told on when simulation has to end and the ending procedure is given below.

The finish procedure is given as

```
proc stop {} {
global ns tracefd namtrace val
$ns flush-trace
close $trace fd
close $nam trace
exec nam trst.nam & exit 0 }
```

In the finish procedure, the trace file buffer is cleared and graphs are generated in the terminal in a pipelined manner. To execute the graph exec ns graph.tcl command is used.

1) Results

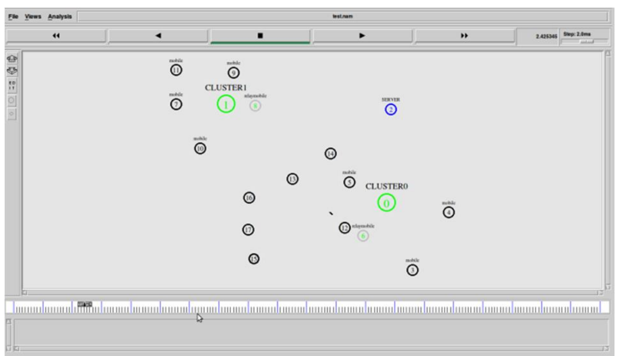

Figure3: Initial position of nodes

The above figure shows that the initial position of nodes.

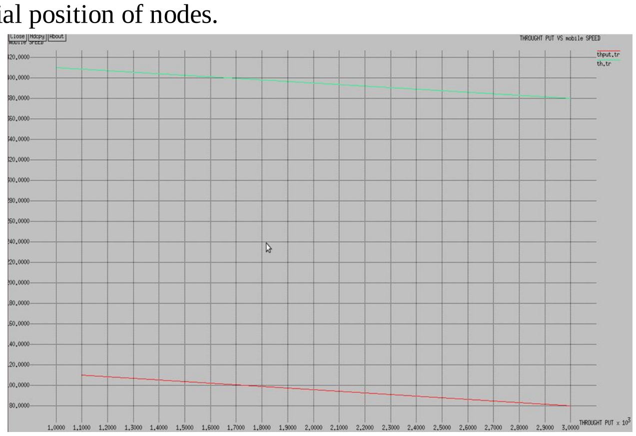

Figure4: Throughput vs Mobile speed

The Fig 4 shows that the throughput of the WITH LOCATION PREDICTION and WITHOUT LOCATION PREDICTION where throughput is high for WITH LOCATION PREDICTION using domain specific algorithm since number of successful transmissions are increased.

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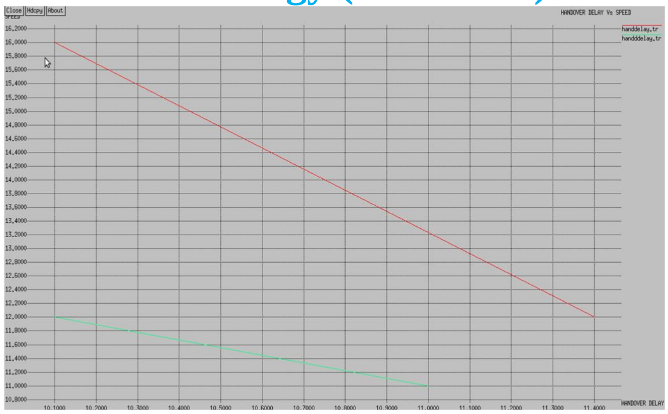

Figure 5: Handoff delay vs speed

The Fig 5 shows that the decrease in handoff latency when future location is predicted than compared to WITHOUT LOCATION PREDICTION. This is because in Location prediction technique, delay at MSC is minimized and number of switching is reduced .

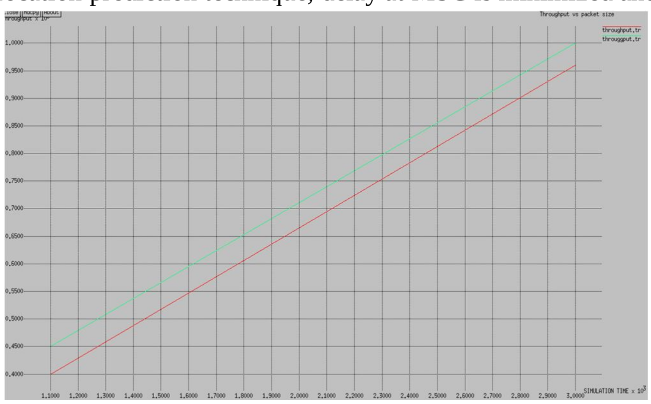

Figure 6: Throughput vs packet size

In mobile networks throughput increases with packet size. The Fig 6 shows that in WITHOUT LOCATION PREDICTION, increase in packet size makes it harder to deliver the packets successfully to the receiver. It also shows that throughput and packet delivery ratio is efficient for our model since the number of switching between base station is less compared to that of in WITHOUT LOCATION PREDICTION.

VIII. 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, also increase in throughput has been shown . 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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