Intelligent Handoff in Cellular Data Networks Based on Mobile Positioning

Prasannakumar J.M.
4^{th} semester MTech (CSE)
National Institute Of Technology Karnataka
Surathkal 575025 INDIA

Dr. K.C.Shet
Professor,
National Institute of Technology Karnataka
Surathkal 575025 INDIA

Abstract: In this paper, we propose an intelligent handoff protocol based on rapidly evolving technology of mobile positioning. We have used predictive channel reservation scheme which work by sending the reservation request to neighboring cells based on extrapolating the motion of Mobile Stations (MS). The area of the cell is divided into Non-Handoff, pre-handoff, and Handoff zone so that the bandwidth is reserved in the target/sub-target cell as mobile stations move into the pre-handoff zone and leave the serving base station. The traffic classes are divided into real time and non-real time categories for prioritizing the handoff process.

We present the detailed algorithm and compare with other existing methods by simulations. The results indicate our method can effectively reduce the handoff call dropping probability compared to existing methods.

I. Introduction

A typical infrastructure for wireless networks is organized into geographical regions called cells [1].The mobile users in a cell are served by a base station. Future wireless networks, however, will have to provide support for multimedia services (video, voice, and data). As such, it is important that the network provides quality-of-service (QoS) guarantees. However, satisfying the QoS guarantees is hard due to user mobility. When a mobile user moves from a cell to another, if the new cell does not have enough resource to accommodate the handoff user, his/her service will be disrupted. therefore, to maintain a consistent service of a user, either a sufficient resource must be reserved in each cell or we must handle the handoff users selectively such that the high priority user can get a better service. In this paper, we will focus on the handoff procedure of the wireless networks.

The guard channel scheme [2, 3] is generally referred as the fixed bandwidth reservation (FBR) scheme which can improve the dropping probability of handoff connections by reserving a fixed number of channels exclusively for handoff connections. The drawback of this scheme is that the reserved bandwidth is often wasted in the hot spot area.

Predictive channel reservation schemes have also examined in the literature [4].

In this paper, we propose and analyze a new channel reservation approach, called *Intelligent Handoff in Cellular Data Network* (IHCDN) based in real time position requirement and movement extrapolation. The underlying assumption of the scheme is that the position and orientation of the MS can be measured/estimated by the MS itself or by the base station (BS) or cooperatively by both MS and BS.

The remainder of the paper is organized as follows. In the Section II, we present the ICHDN scheme. The simulation model and Results are shown in Section III. Finally, we express our conclusion in Section IV.

II. Intelligent Handoff in Cellular Data Network (IHCDN)

We have considered the seven-cell structure of the cellular system, where the area of each cell is divided into non-handoff, handoff and pre-handoff zones. R is the radius of the cell, R_{nh} is the radius of non-handoff zone, R_{ph} is the radius of the pre-handoff zone

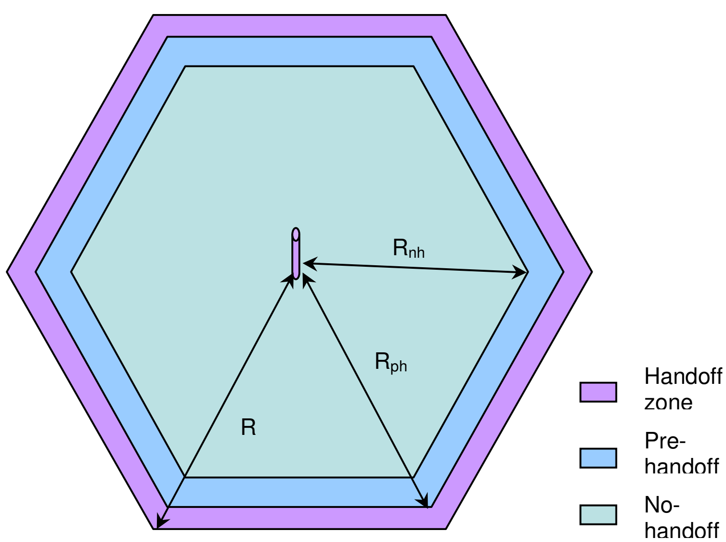

Fig 1. Cell structure

These three zones are determined on the basis of RSS and distance from the Base Station (BS). The propagation model proposed in [8,9] is adopted where the RSS, can be expressed as

$$RSS = -10 * \rho * \log(d)$$

Where d is the distance of the transmitter to the MS and ρ is the propagation path loss coefficient.

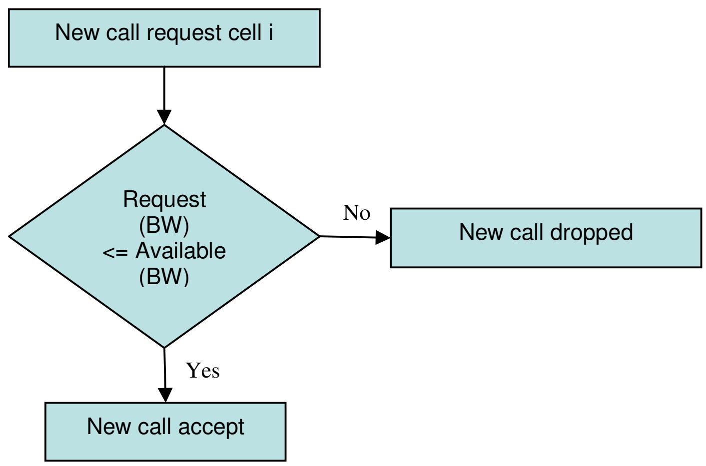

Fig 2. New call arrival

When a new call requests a channel, the BS will accept the call if the requested amount of bandwidth is available.

IHCDN algorithm works by sending the reservation requests to the next possible target cell based on prediction of the motion of MS (when MS is in pre-handoff zone). Position measurement is made by using GPS, GSM, or any other technology (selectable), and orientation can be easily obtained from the vector of two consecutive position measurements taken over a short time. The information is sent to the BS through an uplink message or may be readily available if the positioning is done at the BS itself. The BS uses the position/orientation information to make extrapolation for the projected future path of the MS. Based on the projected path, the next cell (one of the neighboring cells of current cell) that the mobile is heading is determined.

When the MS is in pre-handoff zone, the current BS sends a reservation request to the new BS in order to pre-allocate a channel for the expected handoff event.

(Non-handoff zone is where the signal is strong enough and system will not initiate any reservation requests. In the pre-handoff zone, the signal level is lower than the non-handoff zone threshold. When the MS is in pre-handoff zone, the bandwidth reservation requests are sent to the target cell.)

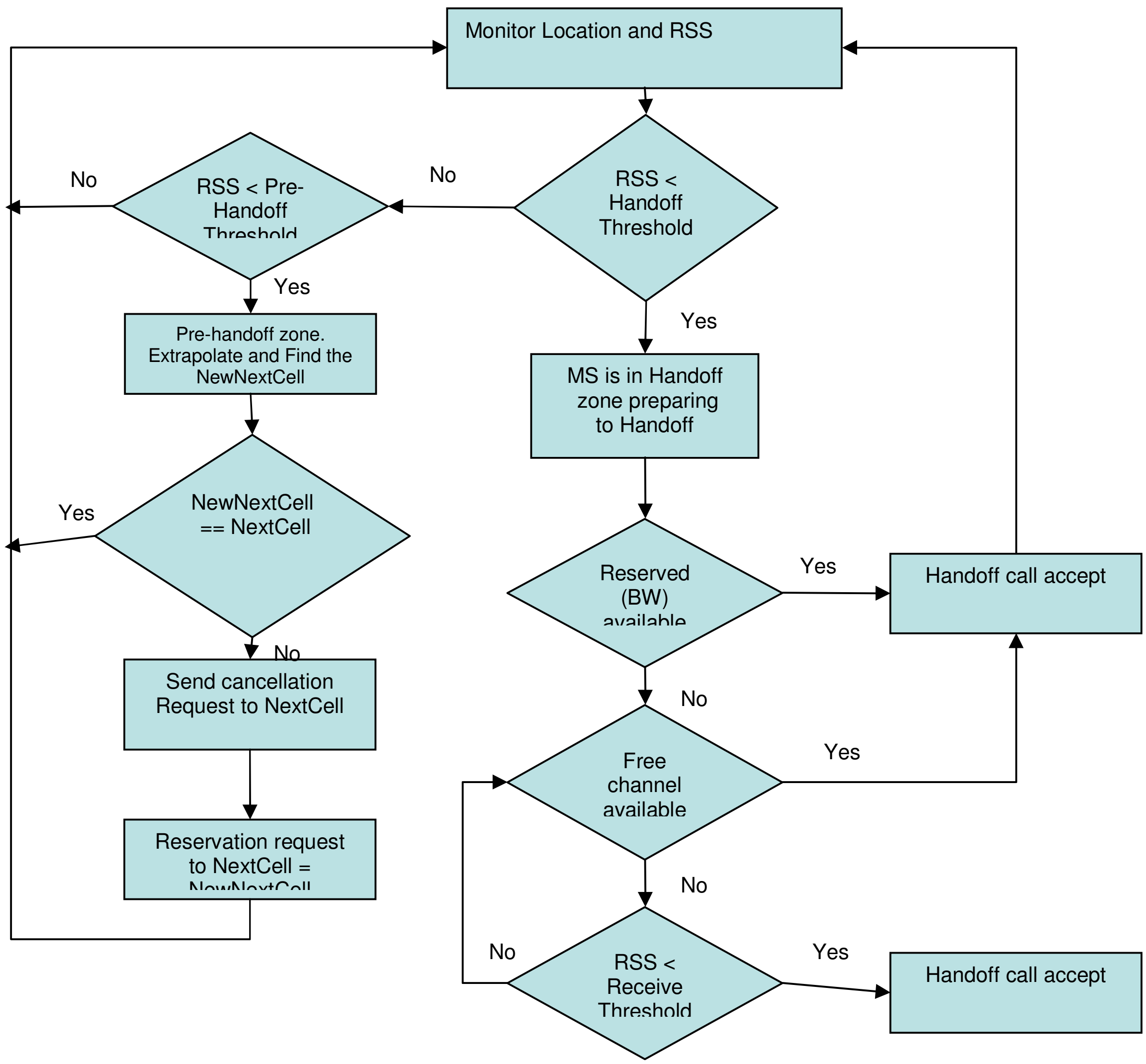

Fig 3. Flow chart of IHCDN algorithm

Fig. 3 shows the flowchart of IHCDN. After a new call (or handoff call from other BS) is accepted, the RSS and location of MS monitored continuously. When the RSS level is lower than the handoff-threshold level, a handoff call request is proposed to the target cell where the mobile user is heading. If bandwidth is reserved or enough bandwidth is available, the handoff call is accepted. Otherwise, the handoff request will be put into the target cell's queue and continuously monitored if the RSS falls below Receive Threshold. In the mean time, if the free bandwidth is available, the handoff request gets the channel.

When the RSS level is lower than the pre-handoff-threshold level and greater than handoff-threshold, the MS will be in pre-handoff zone. The path followed by MS in short time Δt is extrapolated to find the target cell. BS maintains the following two variables for each active MS v in pre-handoff zone.

NewNextCell(v): holds the id of the next cell calculated recently (in current cycle) for MS v

NextCell(v): hold the id of the next cell calculated previously for MS v. The value of this variable is initialized to any negative number (invalid cell id).

Confirmed(v): is a flag indicating whether the BS of cell *NextCell* has granted reservations for MS v.

Below is the code executed by the BS when it collects a new position/orientation measurement for mobile v and when it receives a confirmation of reservation from NextCell(v)

```
New Measurement for v
Extrapolate the path and compute the NewNextCell(v) for v
If(NewNextCell(v) ≠ NextCell(v))
{
        v has changed direction of different cell

        if(confirmed(v))
                { send cancellation to NextCell(v) }
        NexCell(v) = NewNextCell(v)
        Confirmed(v) = False
        Send Reservation request to NextCell(v)
}
else if ( NotConfirmed(v))
        {send reservation request to NextCell(v) }
```

III. Simulation and Results

In the simulation study of the IHCDN scheme, we used a model that adheres to the general assumptions made in the literature. Below is a description of the model

(1) *Cell Model:* The simulation is conducted on an n×n microcellular mobile radio system in which the movement of each MS is allowed to wrap around to the other side of the system when this MS moves out of the boundary. Each cell is considered as a hexagon and has exactly six neighbors. The tests reported in this paper use a 5×5 cellular patch, a cell radius R is of 1000 m, R_{nh} of 800 m and R_{ph} of 950 m.

(2) *Traffic model:* The duration of each call is exponentially distributed with a mean of 180 sec. New calls arrive according to a Poisson process and are homogenous among all cells.

(3) *Mobility Model:* The mobility model which we have considered represents a real-life motion of ground vehicles such as cars. This is done by periodically updating the position of each MS according to controllable probabilities. In each variable-length update period, the MS may move in a straight line, in a curve or even stop for a short time. The direction of the motion after stopping may preserve the previous heading or may change to a new direction. The average speed of MS is 18 m/s and the maximum speed is 24 m/s.

Fig. 4 depicts the handoff blocking rates for the three handoff mechanisms FCA (Fixed Channel Assignment), GC (Guard Channel Based) and IHCDN. As seen from the graph, the IHCDN has low handoff blocking rate compared to FCA and GC based approach.

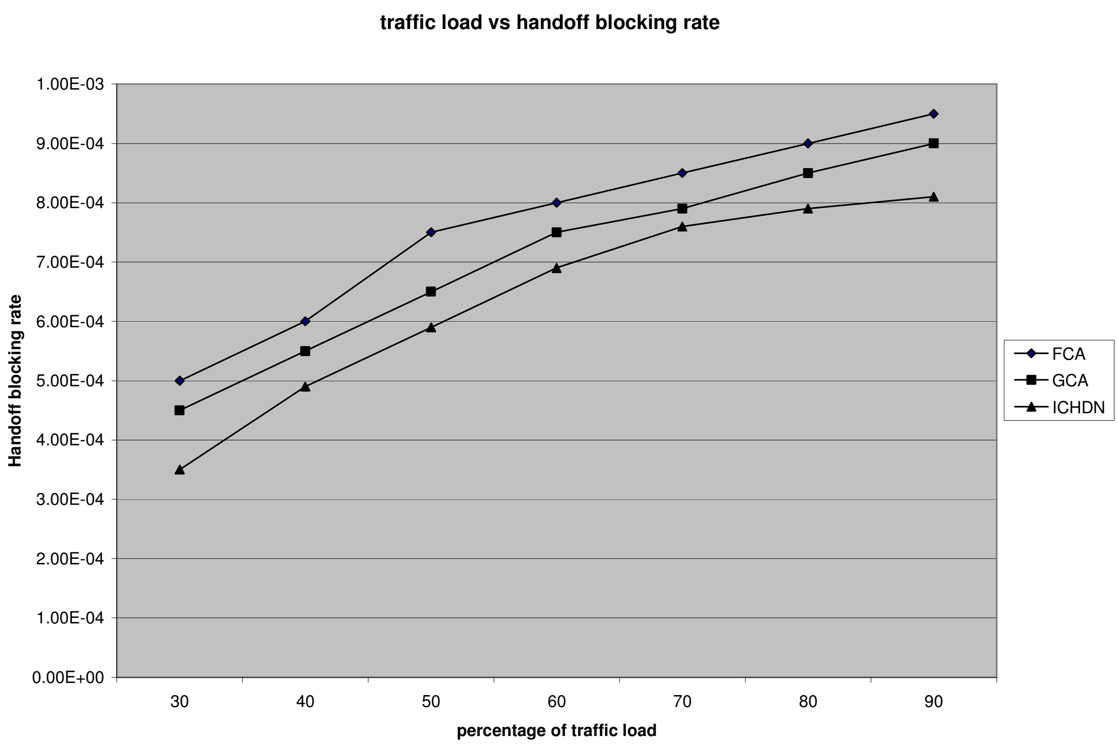

Fig 4 percentage of traffic load v/s handoff blocking rate

Fig. 5 depicts the Number of channels v/s Handoff Blocking rate. As the number of reserved channels increases, the handoff blocking rate comes down.

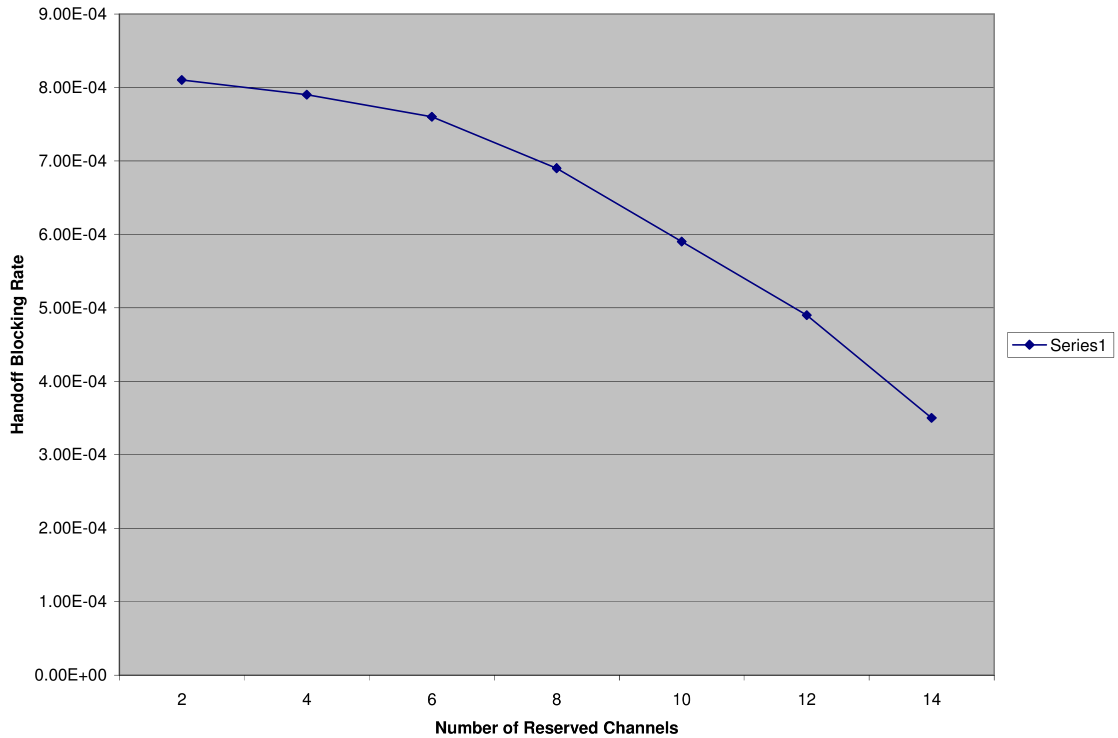

Fig 5. Number of Reserved channels v/s handoff blocking rate

IV. Conclusion

In this paper, we have proposed and evaluated the IHCDN scheme. IHCDN is based on predicting the next possible target cell and reserving the resource. The main aim is to improve the QoS of mobile calls without deteriorating the throughput of the cellular system. The prediction approach seems very promising in terms of performance and its implementation seems feasible in light of recent and remarkable advances in the technology of mobile positioning.

V. References

[1] K. Pahlavan and A.H.Levesgue, “Wireless data Communications,” *Proc. IEEE,* vil. 82, pp.1398-1430, Sept. 1994

[2] D. Hong and S. S. Rappaport, “Traffic model and performance analysis for cellular mobile radio telephone systems with prioritized and nonprioritized handoff procedures,” IEEE Trans. Veh. Technol., vol. VT-35, pp. 77–92, 1986.

[3] N. D. Tripathi, J. H. Read, and H. F. VanLandingham, “Handoff in cellular systems,” *IEEE Personal Commun.,* pp. 26-37, Dec. 1998

[4] S. Choi and G. Shin, “Predictive and adaptive bandwidth reservation for hand-offs in Qos-sensitive cellular networks,” in Proc. ACM SIGCOMM’ 98, pp. 155–166.

[5] D. A. Levine, I. F. Akyldiz, and M. Naghshineh, “A resource estimation and cell admission algorithm for wireless multimedia networks using the shadow cluster concept,” IEEE/ACM Trans. Networking, vol. 5, pp. 1–12, Feb. 1997.