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Performance of Communication Networks Handoff System

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Abstract: - Handoff phenomena has a considerable effect on the efficiency of any communication network. Probability of failures occurring because of handoff must be determined. This paper presents the parameters affecting handoff problem of communications networks and optimizing and controlling such parameters to get minimum handoff of the mobiles networks mathematically. The parameters controlling handoff phenomenon are studied and optimized using mathematical and analytical methods. It is found that handoff has bad effects on the mobiles calls, the probability of handoff failures depends strongly on the arrival rate of handoff calls such that as this rate increased the probability of handoff is decreased but this rate has a critical value. In the studied model under a given numeric values the minimum rate of arrival handoff calls was 0.675. The probability of handoff has an inverse relation with handoff rate. The probability of handoff failures depends strongly on the arrival rate of handoff calls such that as this rate increased the probability of handoff is decreased but this rate has a critical value.

Keywords: *- communications, handoff, networks, optimization.*

I. INTRODUCTION

The most important feature of a wireless cellular communication systems is mobility. To get continuity service in communication system is desired, this is achieved by supporting handoff (or handover) from one cell to another. Handoff is the process of changing the channel (frequency, timeslot, spreading code or combination of them) associated with the current connection while a call is in progress [1]. It is often initiated either by crossing a cell boundary or by deterioration in the quality of the signal in the current channel. Poorly designed handoff schemes tend to generate very heavy signaling traffic and thereby a dramatic decrease in quality of service (QOS). The reason why handoffs are critical in cellular communication systems is that neighboring cells are always using a disjoint subset of frequency bands, so negotiations must take place between the mobile station (MS), the current serving base station (BS) and the next potential BS. Other issues like decision making and priority strategies during overloading may also influence the overall performance.

Handoff can be defined as the mechanism that transfers an ongoing call from one cell to another as a user moves through the coverage area of a cellular system. The handover process is initiated by the issuing of handover request. The power received by the MS from BS of neighboring cell exceeds the power received from the BS of the current cell by a certain amount [3]. This is a fixed value called the handover threshold. For successful handover, a channel must be granted to handover request before the power received by the MS reaches the receiver‘s threshold. The handover area is the area where the ratio of received power levels from the current and the target BS‘s is between the handover and the receiver threshold. Each handoff requires network resources to reroute the call to the new base station. Minimizing the expected number of handoffs minimizes the switching load. Another concern is delay. If the handoff does not occur quickly, the quality of service [QoS] may degrade below an acceptable level. Minimizing delay also minimizes co-channel interference. During handoff there is brief service interruption. As the frequency of these interruptions increases the perceived QoS is reduced. The chance of dropping a call due to factors such as the availability of channels increases with the number of handoffs attempts. As the rate of handoff increases, handoff algorithms need to be enhanced so that the perceived QoS does not degrade and the cost to cellular infrastructure does not increase. Fig. 1 shows the handoff scheme.

Handoffs can be 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.

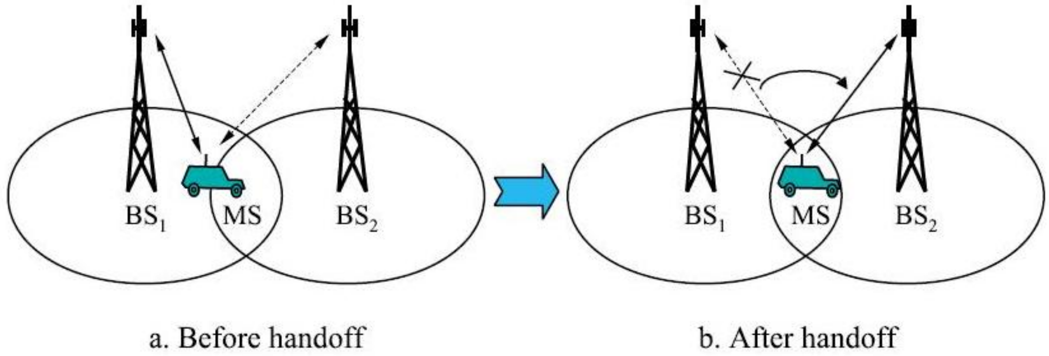

Fig.1 handoff phenomenon

There are many researchers studied and analyzed such problem. Alagu S. et al. (2011) analyzed the different traffic schemes for handoff handling and call blocking attempts. As traffic in mobile cellular networks increases, Handoffs will become an increasingly important issue and as cell sizes shrink to accommodate an increasingly large demand of services, newer more efficient handoff schemes need to be used. In this paper the author analyzed the various Handoff schemes for multiple traffic system and simulates an ATM based wireless Personal Communication Network to implement the non-preemptive Measurement Based Prioritization Scheme (MBPS). Antti M. (2007) introduced a new 802.16e-2005 amendment to the 802.16-2004 standard generally known as WiMAX such device has new feature that support the handoffs, which can be considered as a basic for any mobile communication system.

Zufan Z. et al. (2014) introduced the impact of the width of the antenna beams playing on the dwell time probability density function in cellular geometry with smart antenna. The research results indicate that the smart cell structure can improve the dwell time of users within the cell and improve the traffic system performance. Rajkumar.B. et al. (2014) discussed the issues of the wireless environment such as frequent handover/handoff (user mobility), temporary disconnection, burst error and fading. These characteristics of wireless environment deteriorate the performance of wireless systems sharply in terms of TCP throughput as TCP is basically designed for wired networks to provide reliable delivery by using congestion control and error control mechanisms. In mobile IP based network, mobility plays an important role as handover issue makes negative impact on system performance and to enhance the behavior of TCP during handoff, a novel scheme is proposed. Wireless-TCP is a new wireless end to end transmission control protocol, designed to support the TCP handoffs in mobile IP based network by utilizing the basic features of Mobile IP, Route Optimized Mobile IP and TCP. Gurumurthy G D. et al.(2014), they proposed a Link Quality based routing and handoff for 4G network. Considering link quality in routing decisions rather than hops ensures that the obtained routes are optimum in terms of packet delivery and lifetime of the path.

II. MATHEMATICAL MODELING

The probability of handoff occurring is calculated here. Also the call blocked ration, the number of handoff failures and throughput are calculated too.

Depending on[1], call blocked ratio (R1) can be written as:

$$R_1 = \frac{N_b}{N_p} \tag{1}$$

Where Nb: is the total number of calls blocked, and Np: is the total number of calls processed. This equation can determine the blocked ratio of between blocked calls and total number of calls in some given slot of time in any communication system.

The second formula used is to calculate the number of handoff failures in some given communication system:

$$HOF = \frac{N_1}{N_p} = \frac{N_1 R_1}{N_b} \tag{2}$$

Where N1: is the total number of handovers not assigned channels.

$$throughput = \frac{TSC + TSH}{N_P} \qquad (3)$$

Where TSC = Total number of calls that have been assigned channels and backbone links.
TSH=Total number of handovers that have been assigned channels and backbone links.
The probability of handoff failure for any call for hexagonal or approximated circular cell phone arrangements can be derived using assumptions in [1] as:

$$P_f = 1 - [\frac{\lambda_H - P_h(1 - B_0)\lambda_0}{\lambda_H P_{hh}}] \qquad (4)$$

Where: Ph: is the probability that the new call that is not blocked would require at least one handoff, Phh: is the probability that a call that has already been handed off successfully would require another handoff, Bo: is the blocking probability of originating calls, Pf : is the probability of handoff failure, and λo: is the arrival rate of originating calls in a cell, and λH: is the arrival rate of handoff calls, [1,3].

III. RESULTS AND DISCUSSION

The first relation shows the effect of number of blocked calls on handoff failures. Fig.2 shows the effect of number of blocked calls of a mobile network has minimum call blocked ratio of 0.01, and the total number of handovers not assigned channels is assumed to be 100 calls. It can be noticed that the handoff failures is decreasing as the number of blocked calls increased.

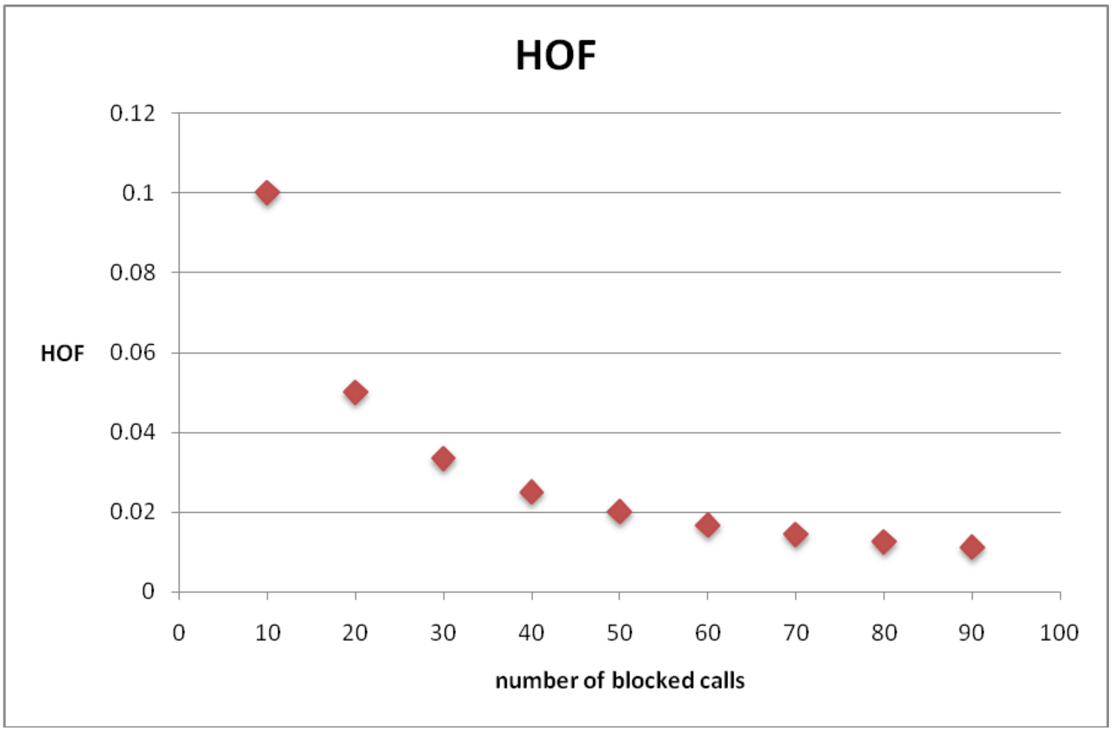

Fig.2 Number of handoff failure as a function with blocked calls.

Fig.3 shows the probability of handoff failures vs. arrival rate of handoff calls. The numeric assumptions are Ph=0.3, Phh=0.2, Bo=0.1, and λo=2. It can be noticed that as the arrival rate of handoff calls increases the probability of handoff failures increases.

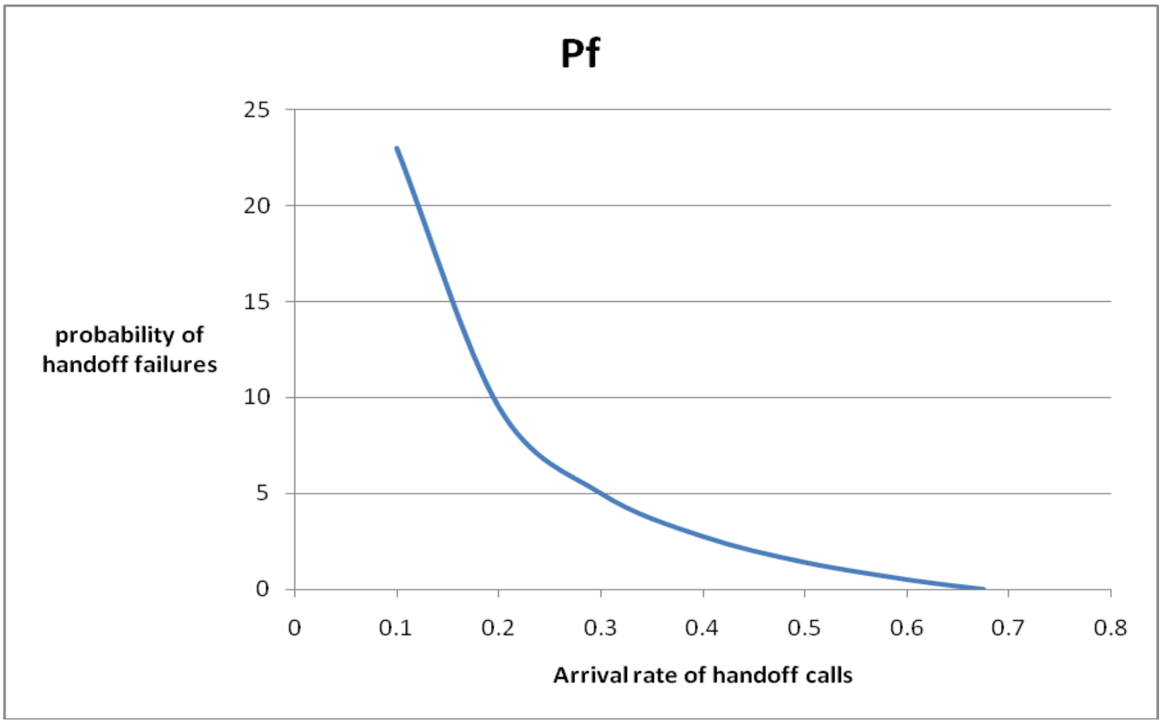

Fig.3 probability of handoff failures vs. arrival rate of handoff calls.

IV. CONCLUSION

It is clear that handoff has bad effects on the mobiles calls, the probability of handoff failures depends strongly on the arrival rate of handoff calls such that as this rate increased the probability of handoff is decreased but this rate has a critical value. In the studied model under a given numeric values the minimum rate of arrival handoff calls was 0.675. It is recommended to go more deep in analyzing this phenomenon by determine the position of handoff between networks boundaries in more specific way.

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