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Development of efficient non-prioritized call admission control model (ENCAC) for low traffic setting

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ABSTRACT: *In this paper, efficient non-prioritized call admission control model for low traffic setting for minimizing call failure is proposed. This non-prioritized scheme is very useful for light traffic scenario like remote or residential areas. The model considers the signal quality, channel availability and the direction of the mobile terminal to the base station, before making decision on whether or not the call can be admitted. The continuous-time single dimensional birth–death process (Markov chain) was adopted to develop the proposed model. MatLab software was used to simulate and analyze the performance of the proposed schemes in terms of call failure probabilities. Based on these results, it is concluded that the proposed scheme is useful for the wireless systems. Consequently, it is recommended that mobile network providers should implement a scheme that best suits the location in terms of traffic expectations and equipment spacing. This will bring about mobile users' satisfaction.*

Keywords: *Call Failure, Handoff call, Mobility Factor, New Call, Non-prioritized scheme*

I. INTRODUCTION

With the increased demand for wireless communication systems, a guaranteed Quality of Service (QoS) is required in a satisfactory manner, to manage both the incoming new calls and handoff calls effectively. Quality of Service (QoS) provisioning in wireless networks is a challenging problem due to the scarcity of wireless resources, i.e. radio channels, and the mobility of users. Call Admission Control (CAC) is a fundamental mechanism used for QoS provisioning in a network. It restricts the access to the network based on resource availability in order to prevent network congestion and service degradation for already supported users. Usually, a new call request is accepted if there are enough idle resources to meet the QoS requirements of the new call without violating the QoS for already accepted calls. Admitting too many users usually results in a situation where the mutual interference between the connections degrades the QoS for the new user as well for the ongoing connections. This is usually undesirable. Therefore, admission control plays a very important role in providing the user with the requested QoS as well as making an efficient use of the available capacity and preventing the system from an outage situation due to overloading [3].

CAC is such a provisioning strategy to limit the number of call connections into the networks in order to reduce the network congestion and call dropping. In wireless networks, another dimension is added: call connection (or simply call) dropping is possible due to the users' mobility. A good CAC scheme has to balance the call blocking and call dropping in order to provide the desired QoS requirements. Due to users' mobility; CAC becomes much more complicated in wireless networks.

The challenges for achieving optimum spectral efficiency and high data rate in wireless cellular communication networks is increased by the wireless communication environment which is characterized by dynamic channels, high influence of interference, bandwidth shortage and strong demand for quality of service support [4]. In order to support various integrated services with certain quality of service requirements in these wireless networks, the study of Radio Resource Management (RRM), Radio Resource Provisioning (RRP), and Mobility Management (MM) is useful [5].

Another task of cellular system planning is to design an optimal radio network which provides the largest amount of traffic for a given number of channels at a specified level of quality of service. During this process, these objectives are achieved by an accurate traffic characterization and a precise analysis of mobile users' behavior in terms of mobility and traffic. Accurate traffic dimensioning plays an important role in any telecommunications network planning and is particularly important for the performance analysis of mobile and wireless networks. Traffic models are thus of paramount importance for network planning and design. They are useful in areas such as network architecture comparisons, network resource allocations and performance

evaluations of protocols. Mobile networks traffic modeling and dimensioning has been traditionally based on the Erlang B call blocking model which was originally developed for fixed networks.
Many optimization procedures applied to several service aspects are aimed at minimizing the call dropping probability while trying to increase the utilization of the resources. These procedures include; the maximization of service coverage area and of network usage, the minimization of interference and congestion, the optimum traffic balancing among the different frequency layers [6].

II. THE REVIEW OF RELATED LITERATURE

Researchers have continued to develop and enhance various handoff schemes for minimizing call failure rates. This section presents the theoretical as well as practical framework related to the study and the views of other researchers and scholars on issues and topics related to this research. This will be done by examining the various concepts, processes, strategies and approaches as related to call admission control and wireless network systems.

2.1 Call Connection and Performance Metrics for Wireless System

In a wireless mobile network, a mobile user is at liberty to migrate from one cell to another while enjoying seamless connection in the process. Handoff probability, handoff rate, call dropping probability, call blocking probability, channel utilization, outage probability and call completion rate are often used as metrics to assess the network systems performance [5]. According to [6], many optimization procedures applied to several service aspects are aimed at minimizing the call failure probabilities while trying to increase the utilization of the resources. These procedures include; the maximization of service coverage area and of network usage, the minimization of interference and congestion, the optimum traffic balancing among the different frequency layers.

An empirical data analysis report (Table 1) shows the various causes of call dropping in a well-established cellular wireless network. It is established that many phenomena (like propagation condition, irregular user behaviour) become more relevant in addition to channel availability in influencing the call drop. Therefore, it is difficult if not impossible for all attempted calls to reach the switching center successfully for channel allocation [6].

TABLE 1: Occurrences of Call Dropping

Drop call causes	Occurrence (%)
Electromagnetic causes	51.4
Irregular user behaviour	36.9
Abnormal network response	7.6
Others	4.1

Source: [6]

2.2 Call Blocking Probability

When a mobile terminal (mobile user) requests service, the request can either be granted or denied. This denial of service is known as call blocking, and its probability as call blocking probability. The overall blocking probability is the weighted sum of the blocking probability of each region. Fang, 2005, demonstrated that new calls in the soft region are blocked only if both calls are found in the blocking condition. [7] expressed the overall blocking probability as

$$P_b = P_{bH} + (1-P)\, P_{bs}^2 \qquad (1)$$

$P_b$is the overall probability
P_{bH} is the probability in the hard region
P_{bs} is the probability in the soft region.

2.3 Call Dropping Probability

During the life of a call, a mobile user may cross several cell boundaries and hence may require several successful handoffs. Failure to get a successful handoff at any cell in the path forces the network to discontinue service to the user. This is known as call dropping or forced termination of the call and the probability of such an event is known as call dropping probability. Call dropping probability is the probability that a call connection is prematurely terminated due to an unsuccessful handoff during the call life. It is one of the key performance indicators (KPI) used by various operators of cellular service for measuring quality of service (QoS). It generally refers to the phenomenon of call dropping in both voice and data networks. Call dropping refers to the event described as the termination of calls in progress before either of the involved party intentionally ends the call [8]. Call dropping leads usually to an undesirable phenomenon known as forced call termination [9]. Mobile users are more sensitive to call dropping than to call blocking at call initiation. Wireless service providers have to design the network to minimize the call dropping probability for customer care. Call is dropped if there is no available channel in the targeted cell during a handoff, that is, a call is dropped when a handoff failure occurs during a call life. [9] assumed that Pb and Ph are the call blocking probability and handoff blocking probability respectively. Also Pc denotes the probability that a call is completed (without blocking and forced termination) [5]. Then the call dropping probability

$$P_d = 1 - P_b - P_c \qquad (2)$$

$$P_d = 1 - (1 - P_h)^H, \qquad (3)$$

where H itself is a random variable.
Given the call blocking and dropping probabilities P_b and P_d, the call completion probability (P_c) is given by [5] as

$$pc = (1 - pb)(1 - pd) \qquad (4)$$

Intuitively, call completion probability shows the percentage of those calls successfully completed in the network.

2.4 Poisson Arrival Rate Process

[10] re-examined the validity of Poisson arrivals for handoff traffic in a classical cellular network where everything is exponentially distributed. They concluded that handoff traffic is indeed Poisson in a non-blocking environment. However, they claimed that in a blocking environment handoff traffic is smooth. A smooth process is the one whose coefficient of variance is less than one. Similarly, [11] empirically showed that handoff traffic is a smooth process under exponential channel holding times. Using a solid mathematical framework, it was proven that for exponential call holding times, the merged traffic from new calls and handoff calls is Poisson if and only if the cell residence times are exponentially distributed. It is usually assumed that the arrival processes for both new calls and handover calls in the cell are Poisson processes and the average arrival rates are $\lambda_N$and λ_H, respectively. It is usually assumed that the arrival processes for both non real-time new calls and real-time new calls in the marked cell are Poisson processes and the average arrival rates are $\lambda_{no}$and λ_{ro}, respectively. Based on the assumption that the cells are homogeneous, the rate of MUs going out of a cell without completing communication, which is the arrival rate of inter-cell handoff calls, is equal to cell dwell time times average number of users holding channels [12]. Also, the arrival rate $\lambda_{nh}$of inter-cell non-real-time handoff calls and arrival rate $\lambda_{rh}$of inter-cell real-time handoff calls can be given by

$$\lambda_{nh} = E[Cn]\mu_{c-dwell} \qquad (5)$$

and

$$\lambda_{rh} = E[Cr]\mu_{c-dwell}, \qquad (6)$$

whereE[Cn] and E[Cr] are the average numbers of active non-real-time MUs and active real-time MUs in the marked cell, respectively.
According to [13] call arrival rate, usually denoted by λ, refers to the traffic offered expressed as the number of call attempts per unit time. This can be expressed mathematically as:

$$\lambda = \frac{Nc}{14400 \text{ secs}} \qquad (7)$$

where, Nc = Number of Call Attempts/busy hour.
The term grade of service (GOS) denoted by B is used to relate call arrival rate to the performance of a network. This GOS can be mean proportion of time for which congestion exists, or probability of congestion or blocking probability, or probability that a call will be dropped due to congestion.
From [13],

$$B = \frac{Tl}{Tf} \qquad (8)$$

Where T_l = traffic lost, and T_f= traffic offered

2.5 Review of Some Existing CAC Schemes

In [14], the authors investigated the call admission control strategies for the wireless networks in their paper titled “Call Admission Control Schemes and Performance Analysis in Wireless Mobile Networks”. The researchers pointed out that when the average channel holding times for new calls and handoff calls are significantly different, the traditional one-dimensional Markov chain model may not be suitable; recommending that the two-dimensional Markov chain theory be applied. Considering the prioritized scheme (new call bound scheme), they observed the effect of both new call and handoff call traffic loads on the new call blocking and the handoff blocking probabilities.

[15] presented an analytical approach of non-prioritized handoff system model using a typical M/M/S/S queuing model.

[16] proposed a mathematical model to estimate the dropping probabilities of cellular wireless networks by queuing handoff instead of reserving guard channels. Usually, prioritized handling of handoff calls is done with the help of guard channel reservation. To evaluate the proposed model, gamma inter-arrival and general service time distributions have been considered. Prevention of some of the attempted calls from reaching the switching center due to electromagnetic propagation failure or whimsical user behavior (missed call, prepaid balance etc.), makes the inter-arrival time of the input traffic to follow gamma distribution. They evaluated the performance and compared with that of guard channel scheme.

The authors in [17] proposed a new handoff technique (M+G) by combining the MAHO and GC techniques. In the proposed technique, the mobile terminal (MT) reports back not only the received signal strength indicator (RSSI) and the bit error ratio (BER) but the number of free channels that are available for the handoff traffic as well. This ensures that a handed-off call has acceptable signal quality as well as a free available channel. The performance of this handoff technique was analyzed using an analytical model whose solution gives the desired performance measures in terms of blocking and dropping probabilities. “M + G” scheme is a further improvement over their previous scheme “G + ReHo”. The “M + G” scheme utilizes MAHO in addition to the GCs. In this scheme, even if a channel is available at a candidate BSS, a poor-signal quality call is not handed over to it. Similarly, a good-signal quality call is also not handed over to a BSS with no available channels. Thus, the “M + G” scheme ensures that a handoff call is handed over to a BSS that is able to offer both good signal quality as well as an idle channel, thereby resulting in α →1. α depicts signal strength factor. They modeled the scheme using the Markov reward model.

The dropping probability was given by the steady-state expected reward rate, which can be written as

$$P_d = \pi_c(1-\alpha)\sum_{j=0}^{c-1}\pi_j \quad (9)$$

whereπj, $j = 0, 1, \ldots, c$ is the steady-state probability of finding the system in state j. These state probabilities π_j and $\pi_0$were obtained by solving the balance equations using a birth–death process.

$$\pi_j = \pi_0 \begin{cases} \frac{\rho^j}{j!}, & j \le c-g \\ \frac{\rho^{c-g}}{j!}\rho_h^{\,j-(c-g)}, & j \ge c-g \end{cases} \qquad (10)$$

here $\mu = \mu_1 + \mu_2$, $\rho = (\lambda_n + \alpha\lambda_n)/\mu$, and $\rho = \alpha\lambda_n/\mu$, and

$$\pi_0 = \frac{1}{\sum_{j=0}^{c-g-1}\frac{\rho^j}{j!} + \sum_{j=c-g}^{c}\frac{\rho^{c-g}}{j!}\rho_h^{\,j-(c-g)}} \qquad (11)$$

[18] developed an effective and efficient handoff scheme using mobile controlled handoff and fractional guard channel techniques. The mobile station measures the signal strength from surrounding base stations and interference level on all channels. A handoff can be initiated if the signal strength of the serving base station is lower than that of other base station by certain threshold. They proposed two models to calculate the blocking probability of new calls and the dropping probability of handoff calls. They carried out the numerical analyses of both the models to investigate the impact on performance of the parameters and comparisons with conventional channel reservation schemes.

III. SYSTEM MODEL DESCRIPTION

The M/M/C/C queuing approach [19] is adopted in this model. The system is considered to be made of many cells. These cells are assumed to be homogenous. This implies that the cells are identical in capacity, performance and characteristics. As a result of this, only one cell will be modeled. The results of this cell (marked cell) are applicable to other cells. Two traffic request types are considered in this analysis. These are the new calls and handoff call requests. Also this is a multiclass model.

The following assumptions are adopted in this system model.

1. Both the new call and Handoff arrival rates in the cell form a Poisson process with mean values of λ_N and λ_H respectively. Therefore total arrival rate is $\lambda = \lambda_N + \lambda_H$
2. New call and handoff completion time are exponentially distributed with mean rates of μ_N and μ_H respectively. Therefore the effective service rate is $\mu = \mu_N + \mu_H$
3. The change in arrival rates is moderate in that the network reaches steady state between any two changes in the arrival rate.

Therefore the incoming traffic rate (call arrival rate) is $\lambda = \lambda_N + \lambda_H$

Let us consider a cell mode of C channels. In this scheme, no priority is given to any request (new call or handoff). Therefore all the system resources (channels) are shared equally by both the new calls and handoff requests. This is implemented using the first-come first-served (FIFO) protocol. In this proposed scheme, it is assumed that the signal strengths of both requests are good enough with a factor of γ. The analysis in [15], presumes that a new call and handoff call are always at acceptable signal quality. Considering a real life case, there may be a small probability that such request do not have acceptable quality of signal. In this research, it is assumed that γ and $(1- \gamma)$ are the probabilities that the system is processing a good and bad request respectively. The reality is that all BSS do not provide the same signal quality all the time. Therefore, the belief that $\gamma = 1$ is not true all the time. In this model, both the signal strength and channel availability is considered. Another very important factor under consideration in this model is the direction of movement of the mobile terminal (MT). This is represented as α. The parameter α must be equal to or greater than 0.8 for the call to be admitted. This implies that weak signal calls can be admitted provided they are moving towards the BSS. The idea here is that, the signal strength improves as the MT gets closer to the BSS.

The arrival rate of new calls is $\lambda_{N.}$

The new call arrival is characterized by the equation:

$$\lambda_N = \alpha_N \gamma_N \lambda_{N1} \qquad (12)$$

Where α_N, $\gamma_N$and λ_{N1} are the direction factor, signal strength and arrival rate of new call respectively.

The handoff arrival is characterized by the equation:

$$\lambda_H = \alpha_H \gamma_H \lambda_{H1} \qquad (13)$$

Where $\alpha_{H,}$ γ_H and$\lambda_{H1}$are the direction factor, signal strength and arrival rate of handoff call respectively.

Since any poor-signal-quality request is not dropped immediately, the effective incoming rate isλ.

Where

$$\lambda = \lambda_n + \lambda_H \qquad (14)$$

$$\lambda_n + \lambda_H = \alpha_n \gamma_n \lambda_n + \alpha_n \gamma_H \lambda_H \qquad (15)$$

Since this is a non-prioritized scenario,

$$\lambda_N = \lambda_H = \lambda \qquad (16)$$

$$\therefore \lambda = \alpha (\lambda_N + \lambda_H)\gamma \qquad (17)$$

The effective call service time μ is given as

$$\mu = \mu_N + \mu_H \qquad (18)$$

Whereμ_N and μ_H are the call completion time for new calls and handoff respectively.

Applying the Blocking call cleared policy (BCC) and the Markov one-dimension process approach shown in [15] and [17], the system model is illustrated in fig 1.

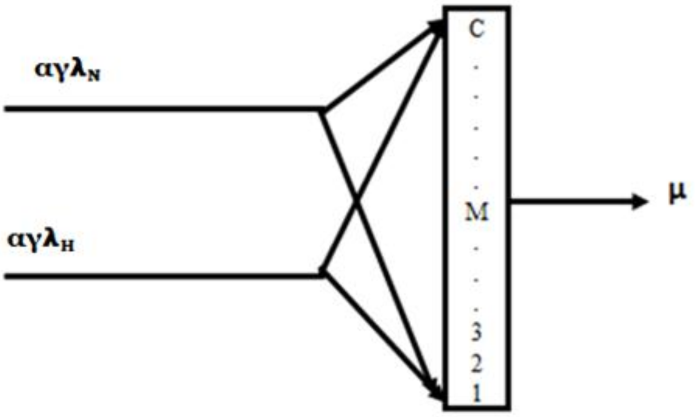

Figure 1: Proposed Scheme system model.

Where 1, 2,…..C are the channels.

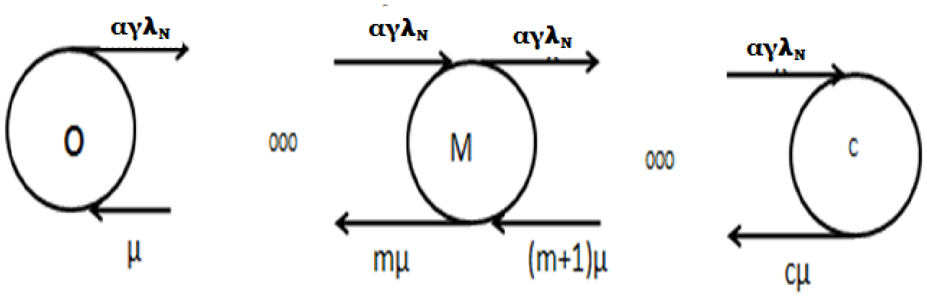

Figure 2: State transition diagram for the model.

Where 0, M and C are the states.

The behaviour of the cell in this system can be described as a (C+1) states Markov process [17] shown in fig 2. Where C is the channel size the states are always represented by integers.
States S = 0,1,2,3, ….. M, M+1, M+2, …… C- 1, C.
If the probability that the system is in state S is represented by P(s), then P(s) can be found using the birth-death process.
Considering the state transition diagram in figure 2, the probability distribution P(s) is found as

$$P(s) = \frac{\lambda}{S\mu} (P (S-1): \quad 0 \leq S \leq C \qquad (19)$$

The normalization condition equation is

$$\sum_{s=0}^{c} P(S) = 1 \qquad (20)$$

Employing this normalization condition in (20),

The steady state (SS) probability P(s) can be determined as

$$P(s) = \frac{\lambda^s}{s!\mu^s} P(0) \qquad (21)$$

$$P(S) = \frac{1}{S!}\left[\frac{\lambda}{\mu}\right]^S P(0) \qquad 0 \leq S \leq C \qquad (22)$$

The expression $\frac{\lambda}{\mu}$ is known as the traffic intensity or offered traffic load in erlang and is represented by.

$$\rho = \frac{\lambda}{\mu} \qquad (23)$$

$$\therefore \; P(s) = \frac{\rho s}{s!} P(0); \qquad (24)$$

Where P(0) is given as

$$P(0) = \left[\sum_{s=0}^{c} \frac{1}{S!}\left[\frac{\lambda}{\mu}\right]^{s}\right]^{-1} \qquad (25)$$

$$P(0) = \left[\sum_{s=0}^{c} \frac{1}{S!}\rho^{s}\right]^{-1} \qquad (26)$$

The new call blocking probability can be denoted as P_{BN} and Handoff call blocking (call drop) or Handoff failure probability as P_{DH}.
In this scheme, P_{BN} is equal to P_{DH} since it is a non-prioritized scheme.

$$P_{BN} = P_{DH} = P(s) = \frac{p^{s}\ x\ P(0)}{s!} \qquad (27)$$

$$PB = \frac{\rho^{S}}{S!}\left\{\sum_{S=0}^{C} \frac{\rho^{S}}{S!}\right\}^{-1} \qquad (28)$$

whereρ is the offered traffic; $\rho = \lambda/\mu$, $\lambda = \alpha(\lambda_N + \lambda_H)\gamma$ and $\mu = \mu_N + \mu_H$

$$P_B = \frac{\frac{p^{C}}{C!}}{\sum_{S=0}^{C} \frac{(p)^{S}}{S!}} \qquad (29)$$

$$\rho = \frac{\alpha(\lambda N + \lambda H)\gamma}{\mu N + \mu H} \qquad (30)$$

$$P_{BN} = P_{BH} = \frac{\frac{\left\{\alpha\left(\frac{\lambda_N+\lambda_H}{\mu_N+\mu_H}\right)\gamma\right\}^{C}}{C!}}{\sum_{S=0}^{C} \frac{\left\{\alpha\left(\frac{\lambda_N+\lambda_H}{\mu_N+\mu_H}\right)\gamma\right\}^{S}}{S!}} \qquad (31)$$

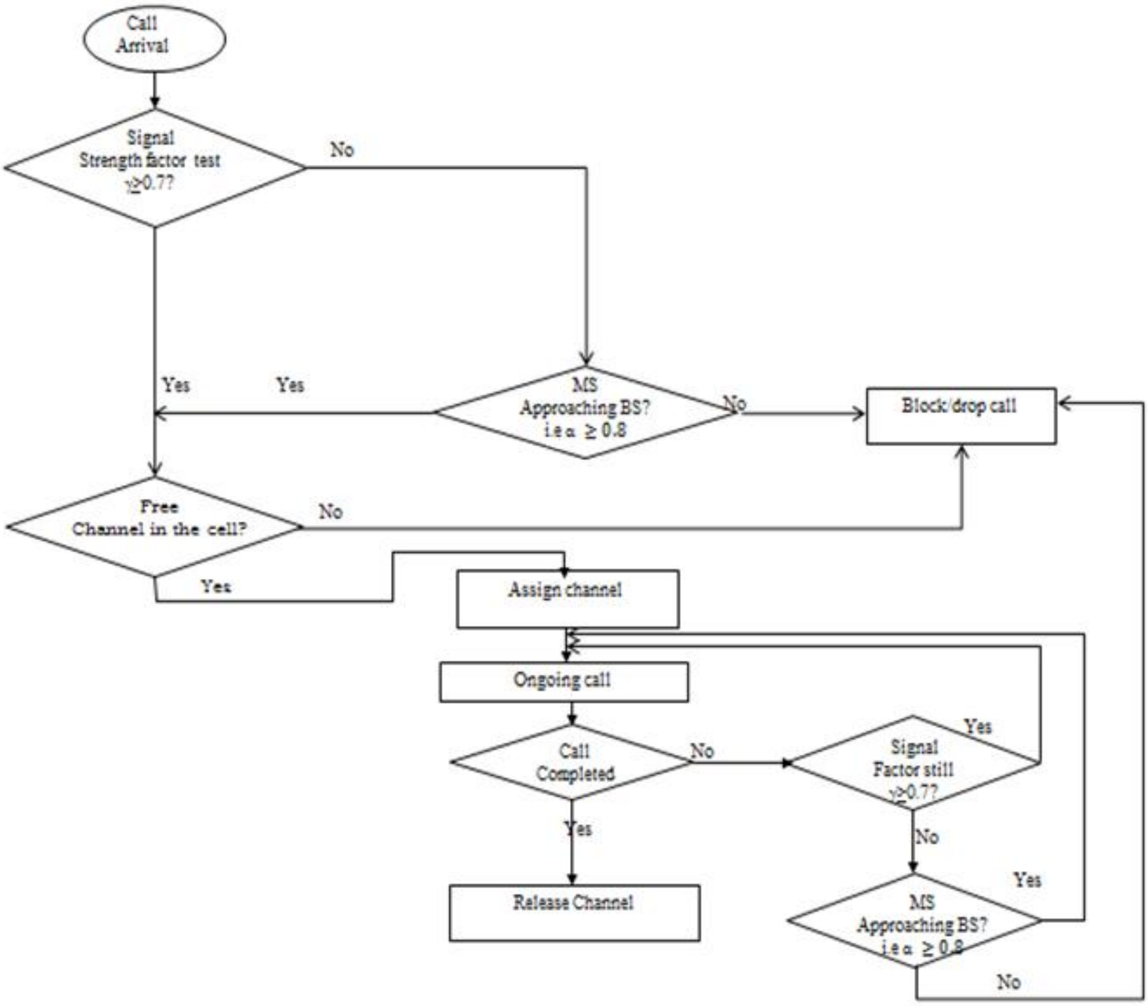

Figure 3 Flow Chart for Scheme.

The flow diagram for ENCAC is shown in fig 3. If at the arrival, all channels are occupied, the call be it handoff or new call, will be dropped.

IV. RESULTS AND DISCUSSION

4.1 The Numerical Analysis Description

Numerical analysis and results for the proposed models are presented and discussed in this section. The effects and impacts of the various parameters on the various system performance metrics are assessed. This is achieved by taking the numerical examples and developing computations for the system performance in terms of call blocking probability.

4.2 System parameters

This section presents the parameters and their values for the computation of the results. The number of channels was varied from 1-34, New call arrival (λ_N) was fixed at 1.5/s and the Handoff arrival (λ_H) was fixed at 2.0/s. The signal strength factor (γ) was varied from 0.7 to 1. The reserved channel size was set at zero (0) (since it is a non-prioritized scheme) to assess its impact on the system performance. The new call duration (mean $1/\mu_N$) and handoff call duration (mean $1/\mu_H$) was fixed at100s and 80s respectively.

4.3 Results Discussion

This section presents the numerical results and computations in tables and graph plots. The results of effect of number of free channels on call failure probabilities at different traffic loads of 40, 50 and 60 Erlangs for the proposed scheme is shown in table 2 and the display is shown in fig. 4. Also the results of effect of number of free channels on call failure probabilities at different traffic loads of 20, 30 and 40 Erlangs for the proposed scheme is shown in table 3 and the display is shown in fig. 5. Table 4 shows the numerical results of effect of traffic on failure probabilities for the proposed scheme at different number of free channels of 8, 11 and 16. The graphical representation is shown in fig. 6. Fig. 3 shows the effect of number of free channels on call failure probabilities at Erlangs of 40, 50 and 60. It is observed from this graph that the failure probabilities have invariant relationship with the number of free channels. As the number of free channels increases, the failure probabilities decrease significantly. This can be explained from the fact that as the number of free channels increases, more calls, can be handled. In essence, the more the system capacity, the more call requests the system can handle therefore, the less the calls will be lost. It can also be observed that, as different traffic scenarios, the performance of the scheme seems to be different. As the traffic increases, the failure probabilities also increase as depicted by fig. 6. This is obvious because, as more call requests arrive, the channels will be congested resulting in some calls being rejected or lost as the case may. In fig. 5, the number of free channels is varied between 3 to 7 and the traffic kept at 20, 30 and 40 erlangsrespectively. Table 4 and fig. 6 depict the effect of Traffic loads on call failure probabilities. There is direct relationship between the traffic and the loss probabilities. The increase in traffic resulted in a significant increase in the loss probabilities. This is as the result of the fact that the channels get congested as the traffic pattern increases which causes the calls to be dropped or rejected. It can then be concluded that the proposed scheme is best for low traffic scenes like the rural areas and remote areas where heavy traffic is not expected.

Table 2: Number of free channels on failure probabilities at different traffic loads for the proposed scheme

No of Free Channels	Failure probabilities Traffic of 60 Erlang	Failure probabilities Traffic of 50 Erlang	Failure probabilities Traffic of 40 Erlang
5	0.01802	0.01406	0.01001
6	0.01301	0.00951	0.00601
7	0.00900	0.00650	0.00300
8	0.00701	0.00276	0.00150
9	0.004515	0.00205	0.00111
10	0.00250	0.00150	0.00050
11	0.00205	0.00141	0.00045

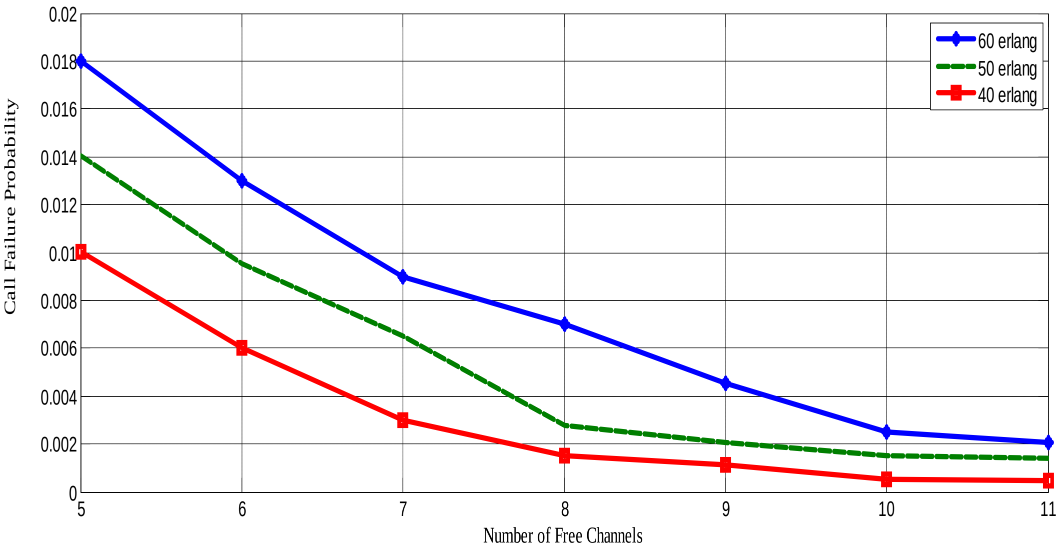

Figure 4: Effect of free channels on call failure probabilities at Erlangs of 40, 50 and 60.

Table 3: Number of free channels on failure probabilities at traffic loads of 20, 30 and 40 Erlangs for the proposed scheme.

No of free channels	Failure probabilities Traffic of 40 Erlang	Failure probabilities Traffic of 30 Erlang	Failure probabilities Traffic of 20 Erlang
3	0.02300	0.01752	0.01050
4	0.01551	0.01026	0.00450
5	0.01001	0.00550	0.00251
6	0.00601	0.00250	0.00050
7	0.00300	0.00151	0.00046

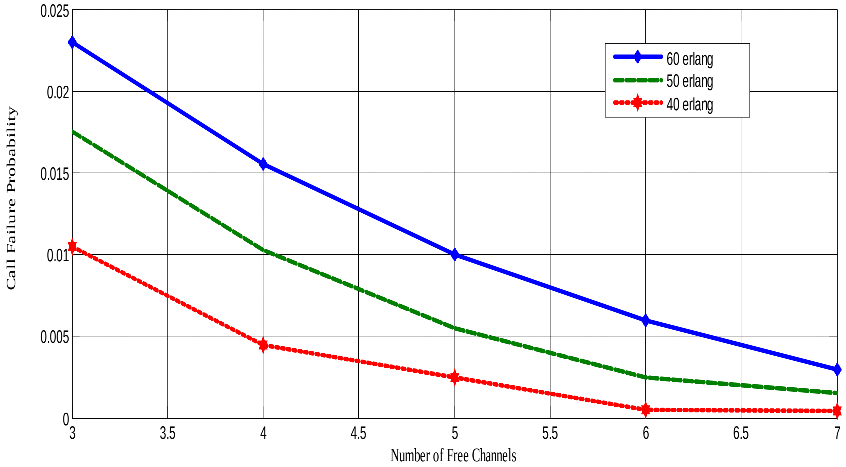

Figure 5: Effect of free Channel on call failure probabilities at Erlangs of 20, 30 and 40

Table 4 Traffic on call failure probabilities for the proposed scheme at different free channels.

Traffic in Erlang	Failure probabilities at free channel of 16	Failure probabilities at free channel of 11	Failure probabilities at free channel size of 8
10	0.00073	0.00934	0.01370
30	0.00367	0.01200	0.01934
60	0.01154	0.01887	0.02471
90	0.01500	0.02274	0.02900

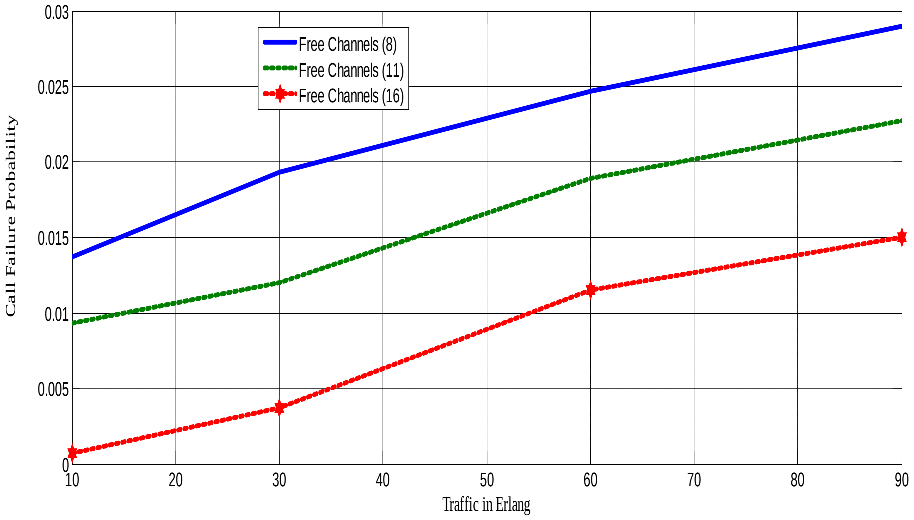

Figure 6: Effect of traffic on call failure probabilities at free channels of 8, 11 and 16.

V. CONCLUSION

The analysis on the performance of different handoff and mobility management schemes in mobile networks has been carried out in this research. A model for evaluating the performance of mobile systems using the analytical method has been studied also. Also carried out in this paper is the performance analysis of various prioritized and non-prioritized Handoff schemes employed by cellular mobile networks. A low traffic non prioritized scheme has been proposed in the paper. The scheme for low traffic area considers signal strength, number of channels, call duration, call arrival rates and the mobility factor as its network characterization parameters. The performance of the proposed scheme in terms of call blocking and dropping probabilities was carried out. It has been demonstrated through analytical computations that the proposed scheme performance is in line with recommended minimum lost call probability. It can then be concluded that the proposed scheme is best for low traffic scenes like the rural areas, remote or residential areas where heavy traffic is not expected.

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