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Handoff schemes and its performance analysis of priority within a particular channel in wireless systems

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Abstract— The whole civilization in the world is dependent on wireless technology. The Gradual growth or development of current environment of the people is not possible without communication. As the use of wireless/ mobile devices increases, there is increment in the requirement of the quality of the service for the users. If there is network congestion, call block and call drop then such requirement is obvious. To deal with this issues (call drop, call block and congestion), we proposed this model. In this paper, we make comparative analysis of that scheme by comparing its performance analysis of priority within a particular channel in wireless systems.
Keywords— Handoff Failure, Mobility Factor, Wireless Networks, Quality of Service, Congestion.

I. INTRODUCTION

During the call, two parties are on a voice channel. When the mobile unit moves out of the coverage area of a particular cell site, the reception becomes weak. The present cell site requests a handoff [1]. The requirement of advancement in wireless technology increases according to the increase in the number of users and the demands on other applications. The user of a cellular or personal communication system wants to use one phone for all of his intended needs. Thus, a single portable phone should be able to operate in a residence, as a cordless phone; in a vehicle using a cellular system, in an office using a WPBX; and outside with wireless local access was proposed in [2]. It describes the present cellular and PCS environments, as well as the evolution of these environments into the 21st century, and explains how broad-band CDMA can provide the one-phone service required by business people as well as people at home. Overview of the current state of wireless communications, including relevant ongoing activities in technology development, standards, and spectrum allocation was given in the [3].
In [4] there is a study about Wireless Personal Communications which has captured the attention of the media, and with it, the imagination of the public. The vision of the third generation is a single set of standards that can meet a wide range of wireless access applications is described in [5]. Third-generation systems, in harmony with broadband integrated services digital networks, will use shared resources to convey many information types. Handoff mechanism is a key element in the provision of guaranteed quality of service in wireless networks. Two important measures in assessing the QoS performance of a mobile system are the new call blocking probability and call dropping probability. The latter is largely as the result of handoffs failures. Most times, the poor QoS experienced in wireless network systems is attributed largely to handoff defects and has caused many mobile users to subscribe to more than one service provider in order to maintain seamless connection. Issues like call admission, connection quality, handoff success and mobility management determine the users satisfaction [6, 7]. Two handoff schemes without and with preemptive priority procedures for integrated wireless mobile networks, categorize the service calls into four different types, namely, originating voice calls, originating data calls, voice handoff request calls, and data handoff request calls and we assume two separate queues for two handoff services [8].
To increase the channel utilization while keeping the quality of service (QoS) of each type for traffic, one type of service is allowed to borrow channels from the other under certain constraints. Different handoff schemes in integrated wireless mobile networks, channels in each cell are divided into two parts and pre-allocated for real-time and nonreal-time services [9]. A method for improving the quality of service (QoS) in multimedia wireless systems based on prioritization of handover requests. A strategy called signal strength for multimedia communications (SSMC) under this strategy, a handoff priority for every multimedia service using three values: the static priority value, the degradation rate of the received signal strength (RSS), and the RSS level itself is mentioned in [10]. A single queue is always considered for the whole cell in microcellular networks. A new model in [11] is proposed with a dedicated queue for each transceiver in the cell. Fixed channel assignment is considered in both models. Performance characteristics based on blocking probabilities, mean waiting time on queue and cost functions are derived in order to compare the two models.
Handoff is a key element in wireless cellular networks in order to provide Quality of Service (QoS) to the users and to support

users' mobility. Handoff failure will result in the forced termination of an ongoing call. From the user's point of view, the service of a handoff request is more important, as the forced termination of an ongoing call is more annoying than the blocking of new calls. Therefore, in order to support QoS to the users and to provide ubiquitous coverage, the handoff procedure ought to be further investigated. A comprehensive survey of the basic elements, the different types and phases of the handoff procedure is described [12]. Moreover, particular interest has been given in the horizontal handoff execution phase by discussing and classifying the most recent handoff prioritization schemes into categories based on the concepts that these schemes adopt, e.g. Channel Reservation, Handoff Queueing, Channel Transferred, Sub Rating, Genetic and Hybrid Schemes and in the vertical handoff decision phase by presenting different decision algorithms [12].

The main objective of third and future wireless mobile communication networks is to provide services efficiently to the mobile users in all environments. In wireless mobile Communication the channel allocation and quality of service are the major factors and important issues to decide the system performance. The work of a Hybrid Channel Allocation (HCA)strategy for channel allocation and queuing technique applied to Hybrid Channel Allocation strategy for Quality of Service(QoS) provisioning are implemented. The proposed HCA strategy considers new calls in Fixed Channel Allocation (FCA) method and handoff calls in Dynamic Channel Allocation (DCA) method to reduce the call blocking and call dropping probabilities. The application of queuing technique applied to HCA strategy increases the efficiency of the cellular system performance especially in micro and Pico cellular environments and effectively utilize the available allocated radio spectrum. The performance shows the decrease in call blocking and dropping and an increased number of users in the available channels [13]. Mobility and radio resource management plays a major role in Quality of Service provisioning for cellular communication systems. Due to the limited radio coverage of a cell, an ongoing call while being handed off may get dropped. 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. Two models are proposed to calculate the blocking probability of new calls and the dropping probability of handoff calls, using call admission control scheme in a cellular system. Numerical analyses of both the models are carried out to investigate the impact on performance of the parameters and comparisons with conventional channel reservation schemes [14].

For cellular communication systems, mobility and limited radio coverage of a cell require calls to be handed over from one base station system (BSS) to another BSS. Due to the limited bandwidth available in various cells, there is a finite probability that an ongoing call while being handed off may get dropped. Minimizing the dropping of ongoing calls during handoff is an important design criterion. Some digital cellular systems, e.g., the GSM and the IS-136 use the mobile assisted hand off (MAHO) in which a mobile terminal (MT) assists its BSS and mobile switching centre (MSC) in making handoff decisions. MAHO requires an MT to regularly report back to its serving BSS, its current radio-link state (defined in terms of the received signal strength indicator (RSSI) and the bit error rate (BER)) of transmissions received from the neighbouring BSSs. Some researchers have suggested that a base station needs to give priority to the handoff calls over the new calls. This requires each cell to reserve a number of guard channels (GCs) to be used exclusively for processing the handoff calls. Since MAHO makes handoff decisions based solely on RSSI/BER measurements, there is a finite probability that some handoff calls may get dropped due to the non-availability of free channels in the neighbouring cell that is being handed off the call. Conversely, if a handoff decision is based solely on the availability of a free channel without regard to the signal quality, it may also result in some of the handed off calls being dropped due to poor signal quality. The performance of this handoff technique is analyzed using an analytical model whose solution gives the desired performance measures in terms of blocking and dropping probabilities [15].

In [16] an overview about the issues related to handoff initiation and decision and discuss about different types of handoff techniques available in the literature is given. II. HANDOFF INITIATION Handoff initiation is the process of deciding when to request a handoff. Handoff decision is based on received signal strengths (RSS) from current BS and neighbouring BSs. [17] provide numerical solutions for new and handoff call blocking probabilities with arbitrary handoff inter-arrival time distribution. For this purpose, we first prove that the underlying stochastic process is a Markov regenerative process and subsequently we use their mathematical theory to develop numerical techniques for important Quality of Service measures. Our results can be seen as a generalization of the recent work by Haring et al. [IEEE Trans. Vehi. technol. 50 (2001) 664] where handoff traffic was assumed to form a Poisson process. This work can be applied for more accurate dimensioning of cellular systems with realistic traffic. In [18] there is a survey on a new analytical approach we have developed in the last few years to evaluate the performance of wireless cellular networks under more realistic assumptions. In particular there is an application of this approach to the analysis of call connection performance and mobility management under assumptions that many time variables such as call holding time, cell residence time, channel holding time, registration area (RA) residence time, and inter-service time are assumed to be generally distributed and show how we can obtain more general analytical results.

The rapid increase in the use of mobile devices demands the need to meet Quality of service requirements of the users. These requirements however, (application demand and allocation) often lead to network congestion and call drops. To deal with this issues (call drop and congestion), many prioritized handoff schemes have been proposed by many researchers. In our previous

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paper entitled "Development of an Improved Scheme for Minimizing Handoff Failure due to Poor Signal Quality", there is a proposed work on a prioritized handoff scheme which integrates the direction of movement of the mobile device to the M+G scheme in making handoff decision in [19, 20]. In this paper, there is a comparative analysis of that scheme by comparing its performance with other existing schemes. In [21] the study of Channel holding time (CHT) is of paramount importance for the analysis and performance evaluation of mobile cellular networks is done. This time variable allows one to derive other key system parameters such as channel occupancy time, new call blocking probability, and handoff call dropping probability.

II. SYSTEM MODEL ASSUMPTIONS

The situation of handoff can be occurs, when in the cars travel into the city, and at night, when the traffic pattern reverses. The system operation does not affected much by the unsymmetrical mobile-unit antenna pattern (assuming large backward energy from the motion of the vehicle) if the traffic density is uniform. The traffic is heavier as more cars approach the city, traffic pattern becomes non uniform and the sites nearby the city or in the city, cannot receive the expected number of calls or handoffs in the morning because of the mobile unit antenna patterns. At night, as the cars move out of the city, the cell sites closest to the city would have a hard time handing off calls to the sites away from the city.

To solve these types of the problems, we have to utilize less transmitted power for both set-up and voice channels for certain cell sites. We also have to raise the threshold level for reverse set-up channels and voice channels at certain cell sites in order to control the acceptance of incoming calls and handoff calls. Once a call is established, the set-up channel is not used again during the call period. Therefore, handoff is always implemented on the voice channel. The value of implementing handoffs is dependent on the size of the cell. If a call is dropped in a fringe area, the customer simply redials and reconnects the call.

There are two types of handoff:

A. Based on signal strength.

B. Based on carrier-to-interference ratio.

III. MODEL DESCRIPTIONS

The analytical modeling approach [1] gives an idea to our study about system model given in fig.1. In this study we focus on two traffic request types which are the new calls and handoff call requests. The assumptions of the system model are as follows:

A. The new call and Handoff arrival rates in the cell with mean values of λ_N and λ_H respectively are assumed to follow a Poisson process.

B. The service pattern of the new call and handoff are exponential with mean rates of μ_N and μ_H respectively.

In this model we assume that a new call can assign either free channel or goes to handoff. In free channel there is no any restriction to complete the call and after call completion user release the channel. If the MT is approaching the BS a poor signal handoff request is accepted with α probability. When the MT comes closer to the BS the signal quality is assumed to improve. We denoted this factor as α and it lies between zero (0) and one (1). In fig.2 we depicted the state transition diagram for the system model. To develop a mathematical model for the system we use the queuing theory. The handoff failure probability PHF for the system is given as follows.

$$P_{HF} = \frac{\frac{1}{R!(M-L)!}\left[\frac{(\lambda_N+\alpha\lambda_H)\gamma}{\mu_N+\mu_H}\right]^{(M-L)}\left[\frac{(\alpha\lambda_H)\gamma}{\mu_H}\right]^{R}}{\sum_{i=0}^{L}\frac{1}{i!}\left[\frac{(\lambda_N)\gamma}{\mu_N}\right]^{i}+\sum_{i=L+1}^{M}\frac{1}{i!}\left[\frac{(\lambda_N+\alpha\lambda_H)\gamma}{\mu_N+\mu_H}\right]^{i}+\sum_{i=M-L+1}^{C}\frac{1}{(M-L)!}\left[\frac{(\lambda_N+\alpha\lambda_H)\gamma}{\mu_N+\mu_H}\right]^{(M-L)}\frac{1}{(i-M)!}\left[\frac{(\alpha\lambda_H)\gamma}{\mu_H}\right]^{(i-M)}} \quad (1)$$

Where, λ_N is arrival rate of new calls and λ_H is the arrival rate of handoff calls. μ_N and μ_H are the service rates for new calls and handoff calls respectively. A is the mobility factor and γ signal strength factor. R and M represent the reserved and shared channels respectively. C is the number of channels and i represents the states which is given by.

$$i = C + 1 \quad (2)$$

We presented a flow chart of the system algorithm implementation. This is shown in figure 3. The system parameters used for the analysis is are λ_N = 1.6 per second, λ_H = 1.6 per second, $0.1 \le \Upsilon \le 0.9$, 1 ≤ number of channel(C) ≤ 50, 10 ≤ reserved channel(R) ≤ 40, α = {0.5, 0.7, 0.9}, duration of the new call ($1/\mu_N$) = 75 second and same for the handoff call($1/\mu_H$).

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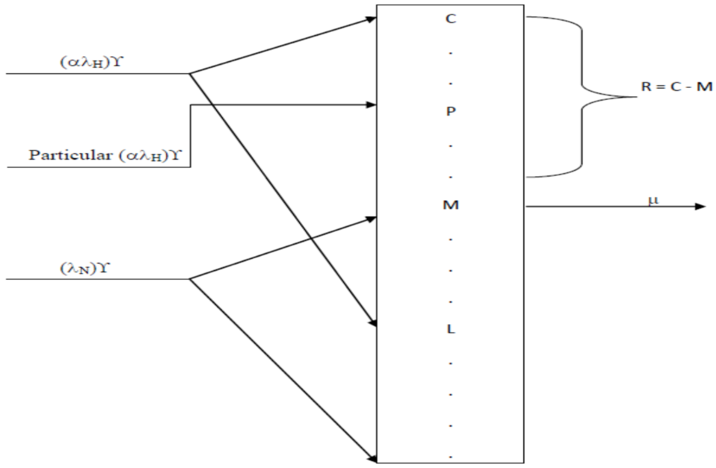

Fig.1.System model

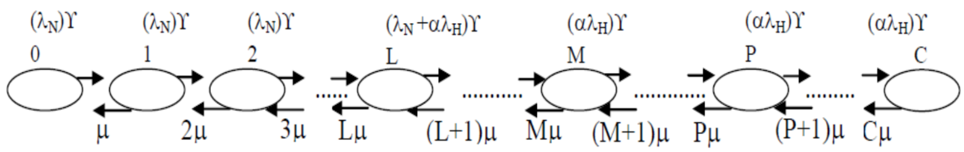

Fig.2. State transition diagram

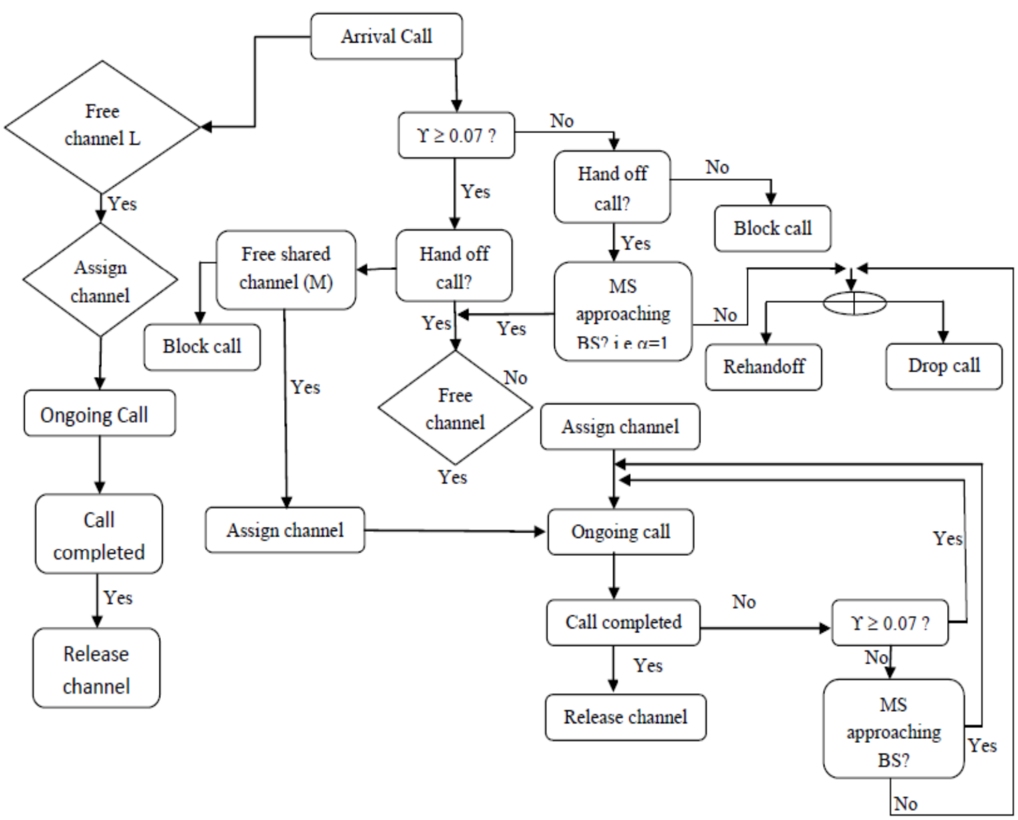

Fig.3. Flow chart for the system model

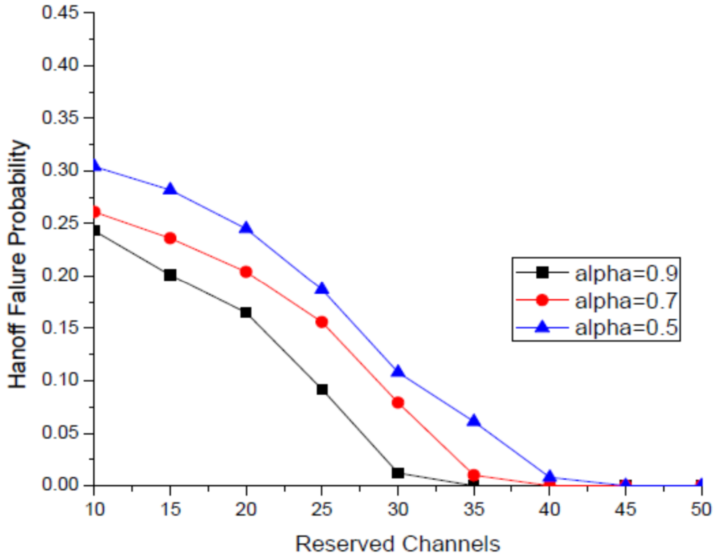

Fig.4. Handoff failure probability with respect to the reserved channel size

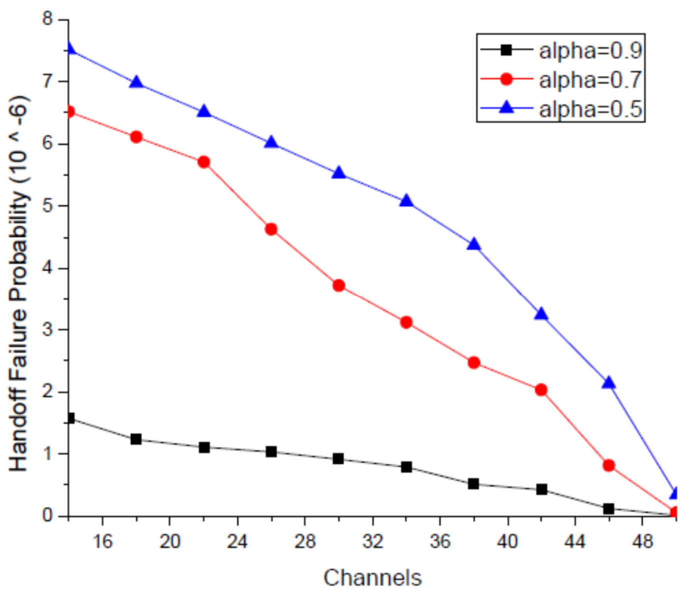

Fig.5. Handoff failure probability with respect to the total channel size

IV. NUMERICAL RESULTS

It is clear from the fig.4 and fig.5 for greater value of the mobility factor α the handoff failure probability decreases. We have analyzed here the handoff failure probability for $\alpha = \{0.5, 0.7, 0.9\}$, handoff failure probability is closure to zero when reserved channel sizes are 40, 35 and 30 for $\alpha = 0.5$, 0.7 and 0.9 respectively. It describes that if the mobile terminal MT is approaching the base station BS then handoff request signal will improve. Fig.5 demonstrates how the handoff failure probability is dependent on size of total channel. Whenever we increase the size of channels handoff failure probability decreases.

V. CONCLUSION

To evaluate the performance of this scheme we use Matlab. The weak signal handoff request will improve as the mobile terminal approaches the base station this is the main concept of the proposed system model that is, if the mobile terminal is approaching the base station. From this model this sure that if α will tends towards the value 1 before accepting the handoff request the handoff failure probability decreases rapidly. The proposed model takes into consideration the channel availability, signal quality and the direction of movement of the MS in making handoff decision. This ensures that fewer handoff calls are dropped.

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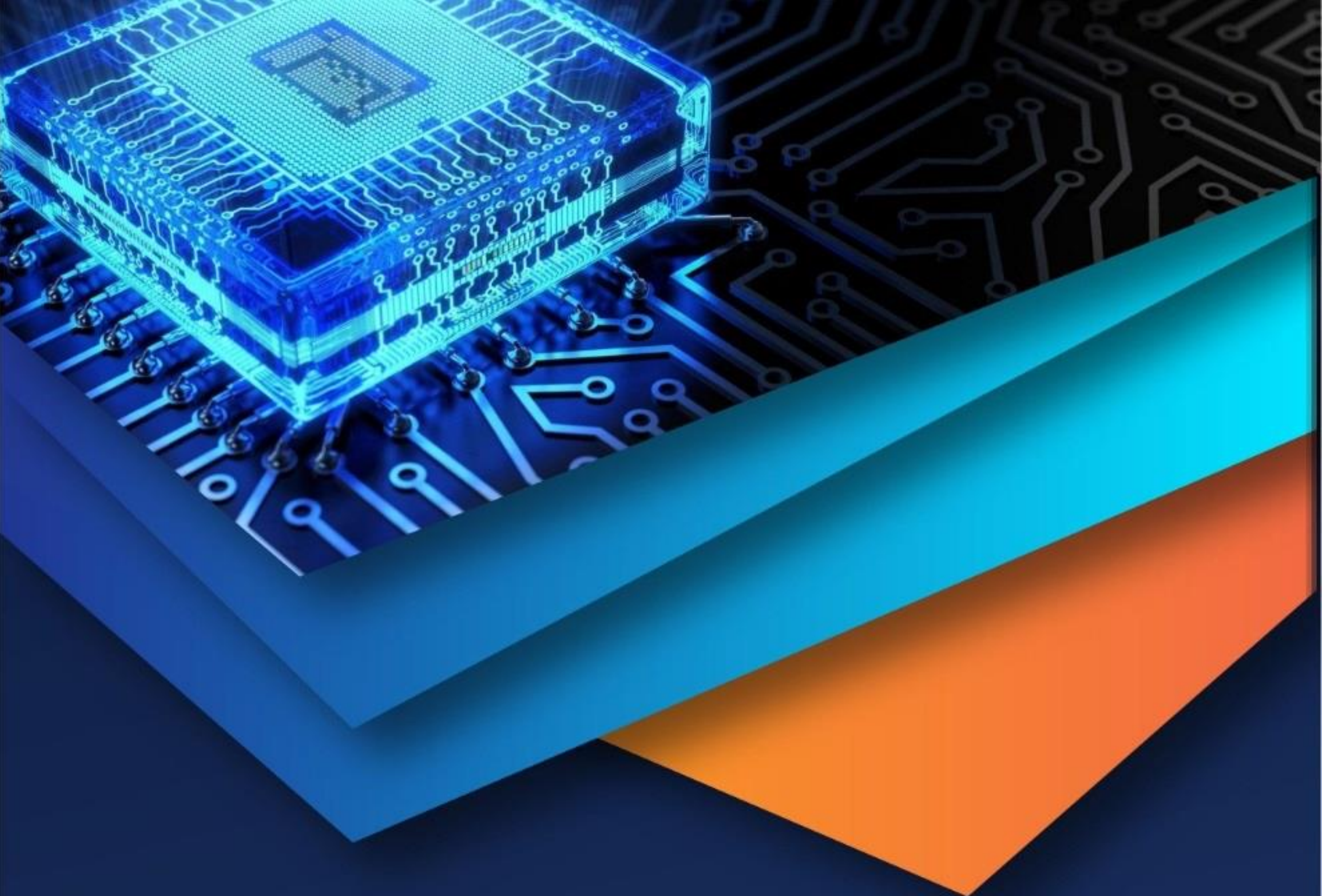

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