

Comparative Analysis of Handoff Queuing Scheme for Minimizing Call Drop Due to Handoff Failure in GSM Systems.

Aniebiet Kingsley Inyang [1] Uduak Idio Akpan[2]* Engr. (Dr). Constance Kalu[3]

1. Electrical and Electronics Engineering Dept., Federal University of Technology, Owerri, Nigeria
2. Electrical/Electronics and Computer Engineering Dept., University of Uyo, Nigeria
3. Electrical/Electronics and Computer Engineering Dept., University of Uyo, Nigeria

* E-mail of the corresponding author: idioh1@yahoo.com

Abstract

The continuation of an ongoing call is an important quality measurement in GSM systems. Handoff process enables a cellular system to provide such a facility by transferring an ongoing call from one Base Station to another. Different approaches have been proposed and applied in order to achieve better handoff service. In our previous paper entitled "Development of Efficient Handoff Queuing Scheme for Minimizing Call Drop Due to Handoff failure in GSM Systems", we proposed and analyzed a scheme integrating the buffer facility to the M+G scheme to further reduce handoff failure. In this paper, we continue with the analysis of this scheme by subjecting it to comparative evaluations with some existing schemes. The simulation environment was done in MatLab.

Keywords: Handoff Failure; Handoff Queue; Mobile Networks; Quality of Service; Call Drop

1. Introduction

There is an ever-increasing demand for wireless communication services as a result of the pervasive development, availability and cost-effectiveness of wireless network. The means to provide omnipresent and seamless wireless network services, which include better voice service, more bandwidth, higher data rates and better QoS while considering overall system complexity, is a major challenge facing the wireless network technology. For a mobile station to communicate with another user or a base station, it must first obtain a channel from one of the base stations that it is talking to. If there is available channel, it is granted to the user otherwise the new call will be rejected. The channel is released either when the user completes the call or moves to another cell before the call is completed. The process whereby a mobile user moves from one cell to another while a call is in progress is known as handoff. While performing handoff mechanism, the mobile unit requires that the base station in the cell that it moves into will allocate it a channel (Sidi & Starobinski 1997). Handoff mechanism is a key element in the provision of guaranteed quality of service in wireless networks. It is the process of changing the channel (frequency, time slot, spreading code, or combination of them) associated with the current connection while a call is in progress. Usually, this is initiated either by crossing a cell boundary or signal quality degradation in the current channel (Akpan, Kalu, Ozoumba & Obot 2013). The term handoff or handover refers to the process of transferring an ongoing call or data session from one base station to an adjacent (neighbor) base station. It is a technique used to provide QoS in a network by regulating the access to network resources by the new calls and the ongoing calls. Simply stated, it is a mechanism that accepts ongoing call request provided there are adequate free resources to meet the QoS requirements of the new/ongoing call requests without violating the committed QoS of already accepted or ongoing calls in that's system (BS). The establishment and management of call connections are important issues in QoS-sensitive wireless networks. This is because the subscribers are expected to move in any direction during the communication sessions experiencing handoffs between cells. The current trend in cellular networks is to accommodate more mobile subscribers in a given wireless area. This could result in more frequent handoffs, and makes connection-level QoS more difficult to achieve. Two important matrices in QoS performance parameters are the probability of blocking new calls and the probability of dropping calls due to handoffs failures. Mobile users, once their connections are set up, should be able to continue with the communication as long as they want as is obtainable in a wired network with QoS guarantees (Choi & Shin 2000). Study shows that it is practically impossible to completely eliminate handoff drops; therefore the best method is to provide some form of probabilistic QoS guarantees. Since dropping a call in progress is more annoying than blocking a new call request there is need for handoff calls to be given higher priority in the system design. According to experts, 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, band with shortage and strong demand for Quality of Service (QoS) support (Akpan, Kalu, Ozoumba & Obot 2013)(Sun, Sauvola, & Howie 2001). In order to support various integrated services with certain QoS requirements in these wireless networks, the study of Radio Resource Management (RRM), Radio Resource Provisioning (RRP), and mobility management is useful (Fang 2005). There are notably two types of handoff principles: the soft handoff and the hard handoff (Nasıf, Tara, Sibel & F. Kemal 2006). In practice, the BS makes handoff decisions with assistance from the MS. If a new BS has some unoccupied channels, then it assigns one of them to the handed off call. Nevertheless, if at the time of the handoff, all the channels are in use, two things could happen; the call could be dropped or it is delayed for a while (Felipe, Genaro & Andrés 2010). 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, and handoff success and mobility management determine the users' satisfaction (Felipe, Genaro & Andrés 2010) (Fang & Zhang 2002).

2. Review of Relevant Literatures

There are many issues and related research works on cellular systems. As the results of the high level of resentment and prolonged dissatisfaction experienced by mobile users due to handoff failures in wireless cellular networks, researchers have continued to develop and enhance various handoff schemes for minimizing handoff failure. The mechanisms are often based on call admission control, handoff prioritized schemes mobility and buffer management for different traffic classes in wireless networks, etc. The various handoff schemes shall be discussed in this section.

Lu & Bharghavan (1996), proposed an adaptive QoS management system in wireless multimedia networks. The system proposed was based on a service model designed for both connection- and application level QoS. Wireless multimedia applications are classified into different service classes in the service model by their application profiles. The system performs an adaptive resource allocation for each service class using the appropriate CAC schemes tailored to the QoS requirements of the service class under consideration. It was demonstrated through analysis and simulations, that the proposed system meets the QoS requirements of different service classes in the system and achieves considerably high network utilization. An analytical approach for performance evaluation of wireless cellular networks was presented in Fang (2005). The analytical approach demonstrated how simple mathematical techniques can be applied to obtain outstanding analytical results for many performance metrics including call blocking and dropping probabilities. The analysis presented more realistic distribution models for the involved random variables. In Yi & Derong (1999), the number of guard channels is allocated automatically in real time to reduce the loss probability of handoff calls. A situation where the handoff calls are queued and no new calls are handled before the handoff calls in the queue is presented in Sirin (1992). Hence, this makes it stricter than the guard channel methods. An integration of direction of mobile into the M+G scheme to reduce the handoff failure was proposed in Akpan, Kalu, Ozoumba & Obot (2013). The scheme utilizes the direction of mobile alongside the signal strength and availability of channels in making the handoff decision.

3. The Proposed Scheme

In our work, Inyang, Opara & Akpan (2014), we developed an Efficient Handoff Queuing Scheme for Minimizing Handoff failure in GSM Systems. The famous M/M/S/S queuing approach was adopted to model the system. In this paper, we will be comparing the performance of this scheme with some existing schemes. Simulation environments were built in MatLab to evaluate the performances of the proposed schemes and comparison with other schemes. The interfaces (GUI) for the simulations are shown in figures below.

ISSN 2222-1719 (Paper) ISSN 2222-2863 (Online)
Vol.5, No.5, 2014

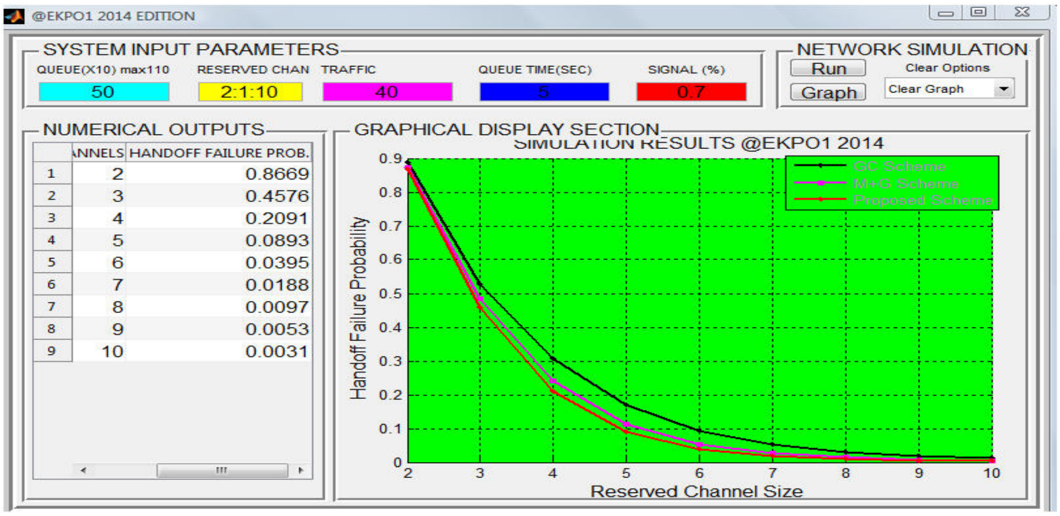

Figure 1 Simulation GUI 1

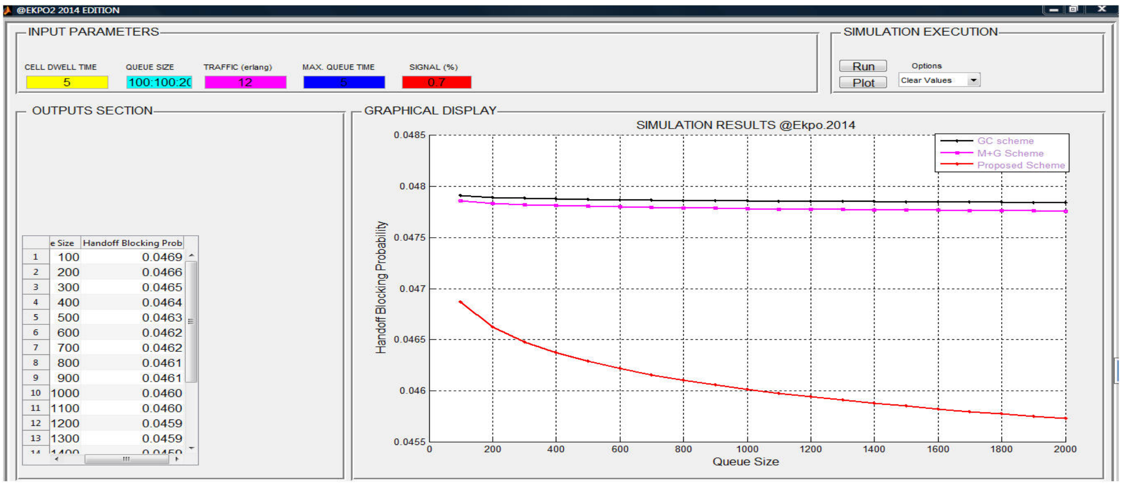

Figure 2 Simulation GUI 2

4. Performance Comparison of the Proposed Handoff Scheme with some existing Handoff Schemes

This section looks into the performance evaluation of the proposed scheme in comparison with other existing handoff schemes. The existing schemes under consideration are the M+G and GC schemes. Figures 3 and 4 depict the Handoff Failure Probability against Reserved Channel size at channel of 50 and 34 respectively. Figures 5 and 6 depict the Handoff Failure Probability against Reserved Channel size at traffic of 50 and 100 erlang respectively. Figure 7 shows the Handoff Failure Probability against Reserved Channel size at queue size of 500. Figures 8 and 9 show the Handoff Failure Probability against Queue size at channel of 34 and 50 respectively. Figure 10 shows the effect of queue size on the Handoff Failure Probability. It can be seen from Figures 3 to 10 that the handoff failure probability of the proposed scheme is lower than that of the other schemes. The graphs indicate that the proposed scheme performs better than the M+G and GC schemes under study. This is because, poor signal handoff calls are immediately dropped in the GC method but the M+G and the proposed scheme take into consideration the channel availability and signal quality. This ensures that fewer handoff calls are dropped. The notable feature of the proposed scheme is the combination of the M+G and the handoff queue. In Figures 8 and 9, the effect of the queue is very obvious. As the queue size increases the failure probability of handoff request decreases for the proposed scheme while the M+G and GC remains relatively constant. This brings about the better performance of the proposed scheme over the other schemes. Figure 10 depicts the relationship between the three schemes in terms of queue size and handoff failure. It can be observed that as the queue size tends to zero, all the three schemes converges. At this point, the three schemes have the same characteristics. Figure 11 and figure 12 show the handoff failure probability against traffic load at queue size of 2000 and 100 respectively for the different Schemes. It is observed that the proposed scheme has a better performance than the M+G and GC schemes. This is as the result of the extra provision made by the handoff queue.

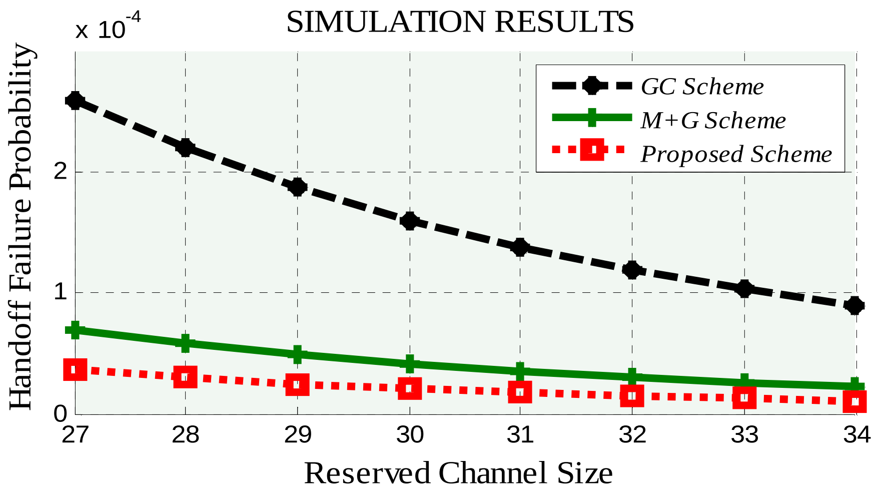

Figure 3 Handoff Failure Probability against Reserved Channel size at channel of 50

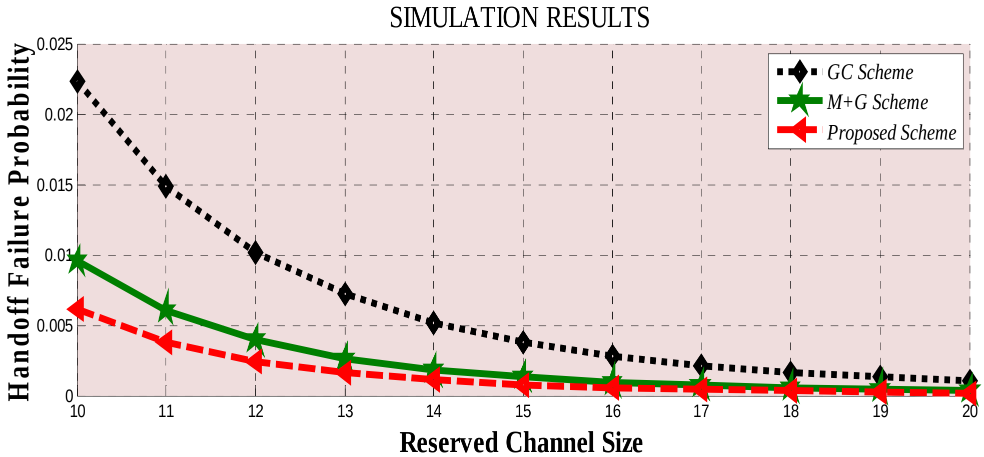

Figure 4 Handoff Failure Probability against Reserved Channel size at channel of 34

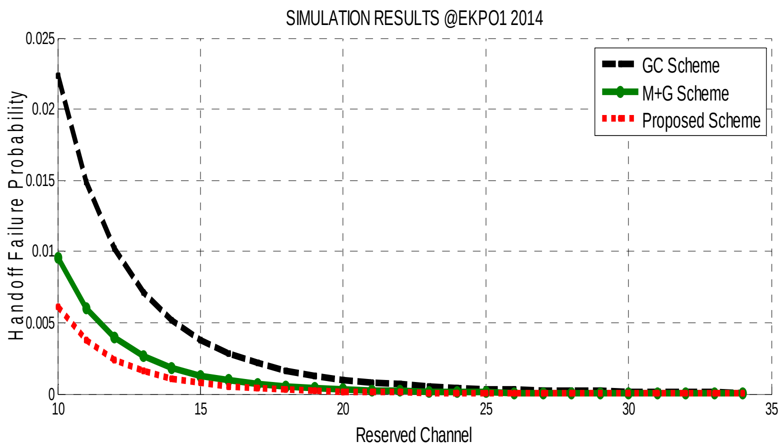

Figure 5 Handoff Failure Probability against Reserved Channel size at Traffic of 50

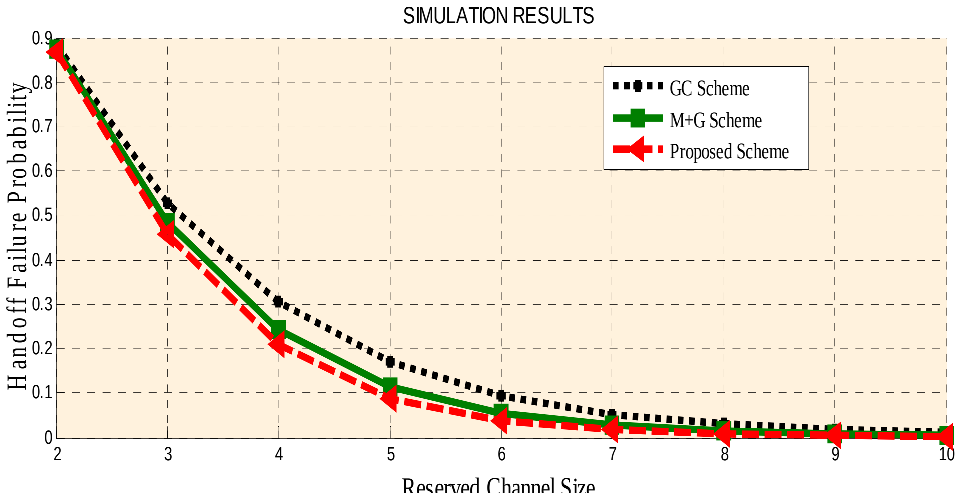

Figure 6 Handoff Failure Probability against Reserved Channel size at Traffic of 100

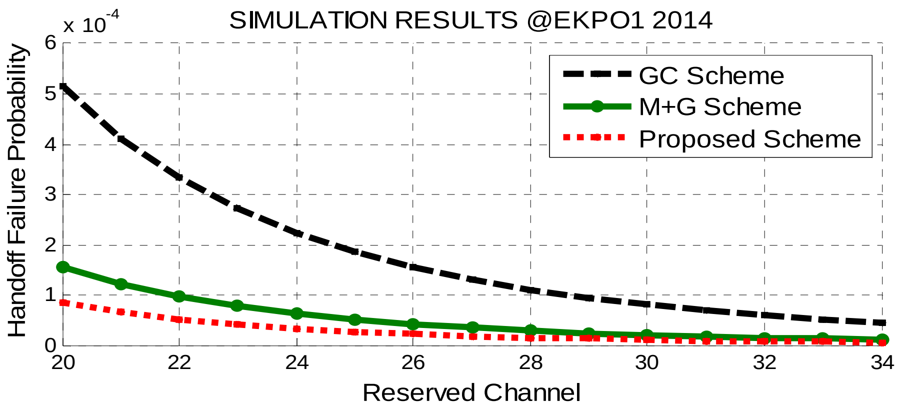

Figure 7 Handoff Failure Probability against Reserved Channel size at queue size of 500

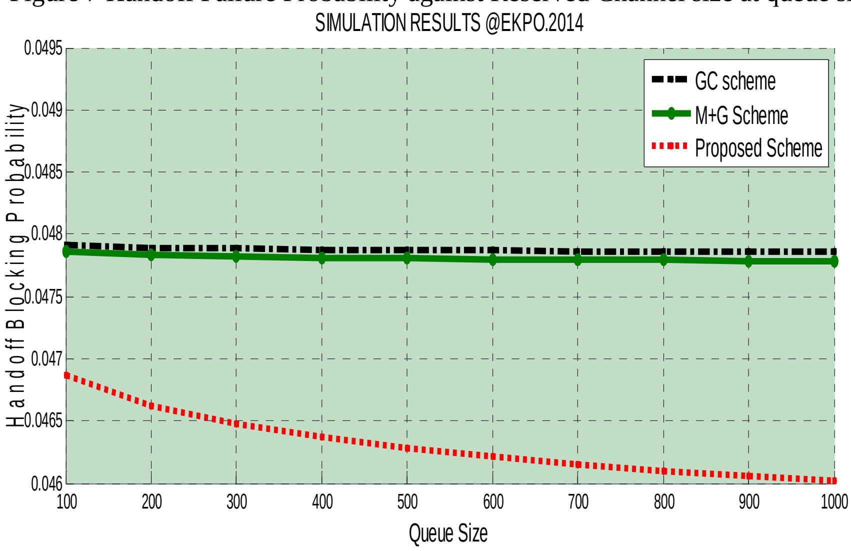

Figure 8 Handoff Failure Probability against Queue size at channel of 34

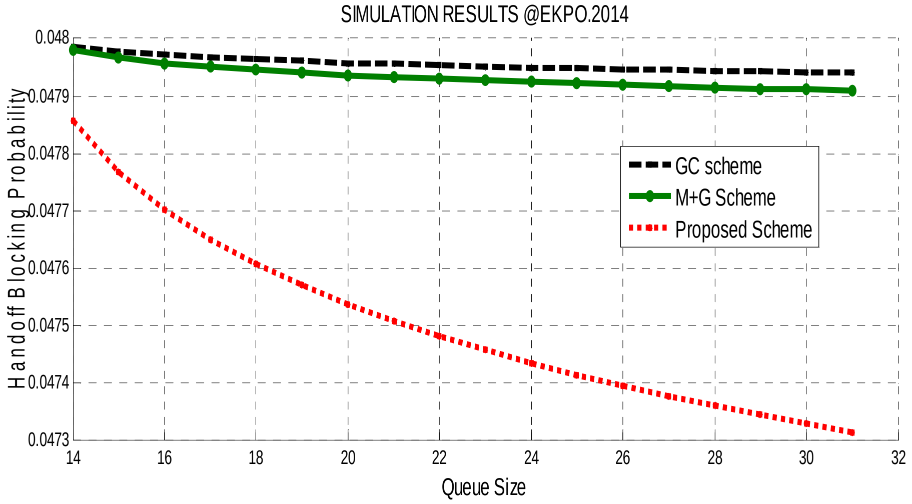

Figure 9 Handoff Failure Probability against Queue size at channel of 50

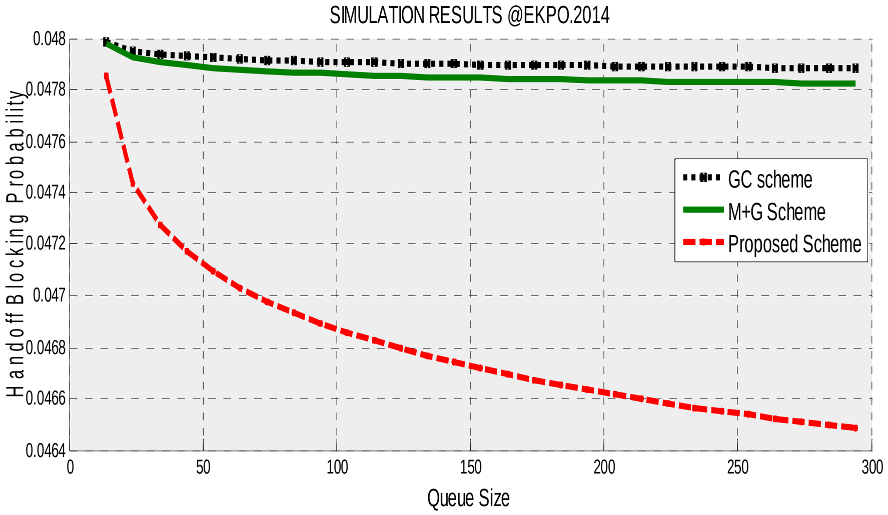

Figure 10 Handoff Failure Probability against Queue size at channel of 34

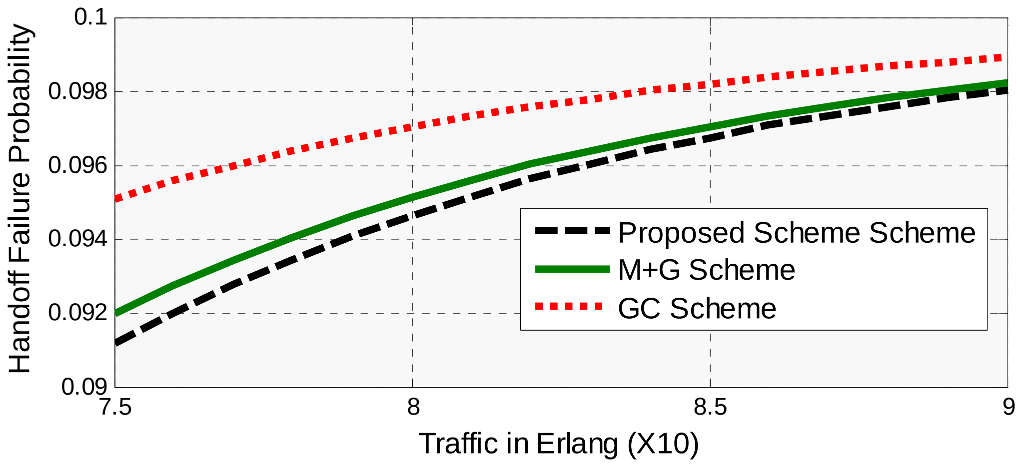

Figure 11 Handoff Failure Probability against Traffic Load at queue size of 2000 for the different Schemes.

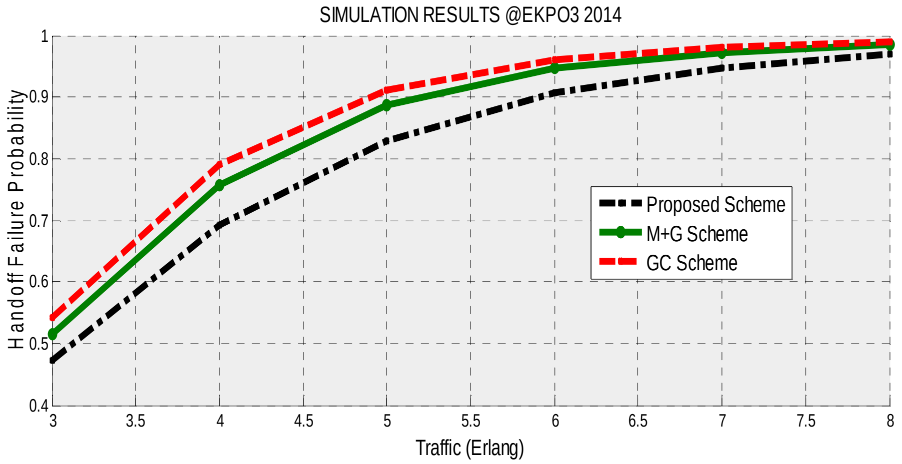

Figure 12 Handoff Failure Probability against Traffic Load at queue size of 100 for the different Schemes.

5. Conclusion

It has been proven that there is a finite probability that an ongoing call might be rejected while trying to establish handoff process. The research work describes the development of a new Handoff control technique in GSM system. Most of the existing research works have not considered buffering handoff calls as a way of reducing its forced termination probability. Instead of deteriorating the quality of service of handoff calls in the presence of new calls, a buffer is introduced to take care of this and the total throughput of the network will increase considerably. In this paper, it has been demonstrated that by integrating the concept of buffering (queue) to the M+G, the handoff call dropping probability has been considerably reduced. The performance of this new scheme in terms of dropping probabilities was carried out using MatLab. The performance of the handoff scheme was compared with other existing schemes. It has been shown that the use of the buffer in the in the proposed handoff scheme helps in further reducing handoff failure in mobile systems.

References

Akpan, U., Kalu, C., Ozuomba, S. & Obot, A. (2013), "Development of an Improved Scheme for Minimizing Handoff Failure due to Poor Signal Quality", *International Journal of Engineering Research and Technology* 2(10), 2764-2771.

Choi, S. & Shin, K. (2000), "A comparative study of bandwidth reservation and admission control schemes in QoS-sensitive cellular networks ", *Wireless Networks* 6, 289–305

Fang, Y. (2005), "Performance evaluation of wireless cellular networks under more realistic assumptions", *Wireless Communications and Mobile Computing Wirel. Commun. Mob. Comput.*; 5:867–885 Published online in Wiley Interscience (www.Interscience.Wiley.Com).DOI:10.1002/ Wcm.352.

Fang, Y. & Zhang, Y. (2002), "Call admission control schemes and performance analysis in wireless mobile networks", IEEE *transactions on Vehicular Technology*, 51(2).

Felipe, A., Genaro, H. & Andrés, R. (2010), "Call-Level performance sensitivity in cellular networks", Electrical Engineering Department, CINVESTAV-IPN Electronics Department, UAM-A Mexico.

Inyang, A., Opara, F. & Akpan, U. (2014), "Development of Efficient Handoff Queuing Scheme for Minimizing Call Drop Due to Handoff failure in GSM Systems", *International Journal of Engineering Research and Technology* 3(4).

Lin, Y.-B., Mohan, S. & Noerpel, A. (1994), "PCS channel assignment strategies for hand-off and initial access", *IEEE Pers. Commun.*3(1), 47–56.

Lu, S. & Bharghavan, V. (1996), "Adaptive Resource Management Algorithms for Indoor Mobile Computing Environments", *In ACM SIGCOMM'96 Proceeding*, 231-242.

Nasıf, E., Tara, S., Sibel, K. & Kemal, F. (2006), "An overview of handoff techniques in cellular networks", *International Journal of Information and Communication Engineering* 2(6).

Sidi, M. & Starobinski, D. "New Call Blocking versus Handoff Blocking in Cellular Networks", *Wireless Networks* 3(1), 1-8.

Sirin, T. (1992), "A Measurement-Based Prioritization Scheme for Handovers in Mobile Cellular Networks", *IEEE JSAC* 10, 1343- 1350.

Sun, J.-Z., Sauvola, J. & Howie, D. (2001), "Features in future: 4G visions from a technical perspective", *In proc. IEEE GLOBECOM'01, San Antonio, USA* 6, 3533–3537.

Tripathy, M., Sharma, A. & Talhi, R. (2009), "Reservation Based Call Admission Control in Wireless Communication", *PIERS Proceedings, Moscow, Russia*.

Yi, Z. & Derong, L. (1999), "An Adaptive Algorithm for call Admission Control in Wireless Networks".

Zeng, Q. & Agrawal, D. P. (2002), "Handoff in wireless mobile networks", Handbook of Wireless Networks and Mobile Computing, edicted by Ivan Stojmenovic. John Wiley and Sons, Inc.